THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XXII.—No. 549.

THE ELECTRIC LIGHT IN RAILWAY TRAINS.

IT would appear that the applicability of the electric light to the illumination of our railway trains is now in a fair way to be thoroughly tested. Trains on the London, Brighton and South Coast line have, for some time past, been lighted by the electric current; and, now for some months also, have trains on the Metropolitan Great Northern system been similarly illuminated. But all these trains are trains *en bloc*, *i.e.*, trains which run to and fro on their journey without being broken up. The lighting of these trains has been accomplished by means of a dynamo and accumulators placed in the guard's van. The dynamo is driven from the wheels of the van, and an electrical or mechanical governor completes or breaks the circuit between the dynamo and the accumulators according to the speed of the train. Provision is also made for the regulation of the current according to the direction in which the train is travelling, so that there may be no reversals in charging the batteries.

To purely local trains this system is possibly applicable, but inasmuch as it involves enveloping any portion of the train which may be disconnected from that portion in which the accumulators and dynamo are placed in darkness, should such a mishap at night time occur, it cannot be regarded as wholly reliable. Still the system has been useful, and has done good work in that it has, so far, served to prove not only the excellence of the light for the purpose, but afforded considerable experience in the application of accumulators, life of lamps, &c. In fact, what has been done has been the accomplishment of a certain stage on the road. We have learnt that secondary batteries may be used for the purpose; that the motion of the train and the usage to which the batteries have necessarily to be subjected have not proved their unfitness for the work. We have also learnt that the vibration of the train does not materially interfere with the life of the carbon filament—that if the lamp is properly fixed and judiciously worked its life may be regarded as equal to that of a lamp employed for illuminating our rooms. These are all stages on the road towards the final application to railway demands.

What these demands are will, we understand, shortly be placed to the test by one of the principal lines. The Midland, a company which has often stood in the van of improvement, and as often advanced the accommodation and interests of the great travelling public, is, we hear, about to fit up two trains upon such a basis as will embrace practically every point of interest to which the question may apply. Each carriage is to carry its own lighting power. The light is to be under the control of the guard, who is to be able to turn it on or off. Should any part of the train or any vehicle become detached the light is to become illuminant; whilst the storage of the current is to be sufficient to insure a light in each vehicle for several hours. This means that the secondary batteries will, instead of being, as in previous trials, placed altogether in the guard's van, be distributed throughout the train, each vehicle having an equal proportion, sufficient to sustain the lamps provided for its illumination for a given period. In accomplishing this there will, of course, be no difficulty; but it will involve greater expenditure on the part of the railway company. There is, however, no other way of effecting the required result, and which no doubt is a most desirable one, viz., the provision of independent lighting power for each vehicle. The batteries thus distributed will be charged by a dynamo placed in the guard's van, driven from the wheels of the vehicle. This will involve the employment of somewhat heavy cables throughout the train, for it is probable that very low currents will be employed in order to reduce the number of cells, although there is very much to be said in the other direction. Here will probably transpire one of the main difficulties to be contended with, viz., a good and reliable coupling capable of carrying the amount of current required—possibly some 60 ampères.

Broadly these are the principles which will, it is understood, be attempted, and which, if attended with success, will at once, no doubt, establish the applicability of the electric light to railway locomotion—a result which will be received by all railway travellers with delight, for nothing can be much more miserable on a long journey than the wretched lights with which our railway carriages are at present, for the main part, illuminated.

It is understood that the experiment will extend over several months, and that the entire working to which a railway train may be subjected will be carried out. This will comprise "slip" coaches as well as the ordinary making and breaking up of the train at points on the journey; certain of the vehicles being detached to accomplish the remainder of the allotted journey at certain points, apart from that portion of the train in which the dynamo is placed. The trial will thus be of the most exhaustive character.

We understand that negotiations are also pending for lighting a portion of the stock of a northern company, but upon what principle has not transpired. The fact is, however, apparent, that railway companies are seeking to improve the lighting of their trains, and are looking to the electric light to aid them in their efforts. We believe they will have no cause to regret their resolve. We are quite of opinion that with proper management large economies will attend the introduction of this form of light for railway train lighting. If successful in its application two important and highly satisfactory results will be accomplished: the companies will provide for the public an agreeable and popular form of light, and, at the same time, effect a considerable saving on their existing cost for lighting.

B

SOME weeks ago we mentioned a laudable attempt on the part of Mr. John Palmer to make a "unipolar" machine with a number of armature conductors. Mr. Palmer has made still another attempt to dodge the "lines of force." His latest machine has a conical armature with ridges, like a bevel wheel. The field magnets or magnet has a conical hole to fit, also with ridges. The magnetic circuit is completed through the bearings, and the conductors are fixed to the projections on the fixed or hollow cone. We do not follow the theory given by the inventor. If he will draw his machine, and imagine the lines of force, he will find it impossible to avoid each cutting his conductor circuit twice in opposite directions. Mr. Palmer has mistaken his vocation. He should have been a burglar. The ingenuity he has displayed in futile attempts to dodge lines of force would enable him to defy the members of the police force with perfect ease.

THE report of Mr. A. Hegener on the establishment of a central station for electric lighting in Cologne is interesting from the gas point of view. It is amusing to note that the author of the report considers even low tension currents may be productive of fire. For our own part we think we are correct in saying that the great percentage of electric light conflagrations has been entirely due to the incandescent system. His opinion, too, upon accumulators is evidently based upon an erroneous impression of their reliability; this, however, will right itself in due course. The quiet way in which he repudiates the statements of Dr. Alex. Sudakoff is worthy of imitation amongst our own fraternity when engaged in scientific discussions, and he very cleverly gives Dr. Karl Strecker a Roland for an Oliver. Altogether his paper is well worthy of perusal and careful consideration.

OUR correspondent, Mr. Jerritt, of Plymouth, deserves the thanks of the electrical, and no less of the medical, community for his outspoken warning, through the local newspapers, to the people of his own neighbourhood against the insidious wiles of the galvanic and "electropathic" belt advertisers. These designing persons have reaped a rich harvest as a result of the misleading statements they have scattered broadcast over the land. The great surprise in this matter is that the proprietors of reputable newspapers lend the influence of their property to the dissemination of the abominable literature which is associated with the trade. It may be difficult to discriminate in all cases between valuable or at least effective remedies and the useless, if not worse than useless, quack wares so largely advertised; but there is in many cases no doubt whatever as to the nature of the things advertised, and it is a lasting shame to journalism and a disgrace to our much-vaunted free press, that influential organs should uniformly admit to their columns the announcements of most notorious charlatans.

The correspondence in the *Western Morning News* upon this subject of electro-medical belts is, in some of its phases, amusing. Mr. C. B. Harness in one letter repudiates all connection with "a notorious person" in Wardour Street, and is indignant because of the unlucky use of the word which he has registered as a trade mark, indicative of his own particular belt, "Electropathic," by Mr. Jerritt in describing another, and, broadly speaking, similar contrivance. He forwarded to the editor of the *Western Morning News* some pamphlets for his perusal, "which will completely disprove Jerritt's assertions."

OUR contemporary, seemingly anxious not to incur Mr. Harness's displeasure, but perhaps only wishing to be strictly just, says that it perceives in Mr. Jerritt's communication no reference, direct or indirect, to the Medical Battery Company or any of its appliances. The "eminent electrician," however, persists that he has been aggrieved, as will be seen in his letter to Mr. Jerritt, quoted in our correspondence columns, and is anxious to know the name and address of his fancied assailant's solicitor. We do not think Mr. Jerritt need be under any great apprehension; indeed, he does not betray that he is. Mr. Harness is wise in his day and generation—his extraordinary success is evidence of that—and he will probably stop short of voluntarily submitting his appliances to skilful dissection in a court of law. Should he be so bold, however, Mr. Jerritt may count upon strong support, for we strongly feel that it is time this incredibly impudent bubble were pricked.

THE several accidents which have occurred with electric light wires in America recently have alarmed the insurance companies, and one company at Chicago has refused insurance to two engineers who had charge of electric light wires. The newspapers have made the most of the opportunity for indulging in a little electrical sensationalism, and it is these which are mainly responsible for the extravagant fears which seem in some quarters to be entertained with regard to the danger of electric light wires. This is to be regretted, for what is needful is that the populace should be correctly informed wherein the danger consists, and a few clear words in the daily newspaper would do this and allay undue fears better than any other agency. It is curious that whilst some of the American papers chronicle in extravagant language, calculated to inflame the excitable tendencies of their readers, the accidents by electricity occurring to foolishly venturesome or recklessly careless persons, they treat as a huge joke the "adventure" of some rustic who, coming to town, puts up at an hotel, blows out the gas in his bed room, and narrowly escapes losing his life by suffocation. An instance of this kind is narrated in a cutting now before us, and it is no more rare a case than that of accidents by electricity; yet there is no clamour that it shall be made impossible for an accident to occur through the instrumentality of gas.

IN the last issue of our esteemed contemporary *Industries*, there appears a very severe criticism on the general conduct of the meeting of the Telegraph-Engineers held on the 17th inst. To a great extent we must admit that this censure was deserved, but it should be remembered that in a public discussion it is almost impossible to separate the author of an observation or a criticism, or the enunciator of a proposition, from the subject matter of his remarks. There are certainly more ways than one of referring to a person who holds a different opinion to oneself, and it is to be regretted that at the meeting in question the wrong method seems to have been adopted in several instances. Putting on one side the personal element which seems to have attracted an excessive degree of attention, to the utter neglect of the more important considerations, surely no body or association could be presumably more unprejudiced, and consequently better qualified, than the Society of Telegraph-Engineers for editing rules for the better control of electric lighting, if it had chosen to set about the task in a business-like manner! The risks attached to lighting affect the public quite as much as they do the fire offices, and the consumers of the light

are more interested in its efficient management than are, perhaps, the suppliers. It is therefore a fair assumption that an independent body would be more likely to consult general interests in the framing of protective rules, than would be the case were those regulations drawn up by an association which, having a large stake to defend, would naturally look first to its own interests.

ONE of the speakers in the late lively discussion on fire office rules as applied to the regulation of electric light installations, appeared to consider inspection as a work of supererogation. He, indeed, admitted that at present it might be necessary, but later on when electric lighting became more general he stated that such inspection would be a nuisance to householders, unnecessary, and not to be tolerated. Now, with gas lighting householders have to submit to the inspection of the gas meters in their houses, and we are not aware that this obligation has proved intolerable, and we have yet to learn that the increase of any industry can have the effect of rendering any less necessary such regulation and control as may be required to ensure efficiency and guard against dangers which may possibly arise from carelessness or through bad workmanship; the many Acts passed for this purpose point rather to the contrary being the case.

IN another place will be found illustrations and a description of Mr. Mordey's new alternating current dynamo which presents features of distinct originality, while at the same time it is evidently a thoroughly practical machine. Mr. Mordey is therefore to be congratulated not only on having produced a new and effective machine, but one which is probably outside the lines of existing patents. In view of the controversies which have now for some time been going on, it is interesting to note that Mr. Mordey's armature is without iron, and that he has reverted to the device of revolving the field magnets, keeping the armature stationary. But the curious part about the machine is that the field magnets are all of like polarity on one side of the armature, the opposite poles being brought to the other side so that the whole constitutes one big electro-magnet, and is treated as such, there being only one exciting coil. The magnetic circuit is, moreover, quite closed, except for the space in which the armature revolves. A certain simplicity is thus ensured in the form of the field magnets, which would probably be cheaper to make than the Siemens type, and, moreover, it is advanced that there is none of the magnetic short circuiting which takes place between the opposite poles on the same side in the Siemens type of machine. The gain in this respect is considerable, although the total exciting power in a well-designed machine is a small fraction of the output. In Mr. Mordey's machine, however, an increased length in the iron portion of the magnetic circuit partly counterbalances this absence of leakage.

TAKE the ordinary Siemens type of machine, cut out every other field magnet on each side so as to leave all N. poles on one side and all S. poles on the other. With the exception, then, that in the Siemens dynamo the armature revolves instead of the field magnets, the principles involved in the two machines are identical. But what has happened to the Siemens machine in this process? Its output for a given size has been halved. In Mr. Mordey's there are nine field magnets, or arms of the field magnet, to 18 coils on the armature, so that only half the useful wire on the armature is employed with the maximum effect at one time. That Mr. Mordey should have been able to make such a large sacrifice and still obtain so good a characteristic curve as that given in the diagram, shows that the design is very good on the principle employed. The fall shown is equal to a loss of 5 per cent. in E.M.F. with constant speed and constant field between the machine running free and at full nominal load. It is a pity this feature of the alternating current machine has not been brought into greater prominence. The reduction of regulating gear to a minimum eliminates a source of failure in itself, and a further source when it has to be worked by human agency, which, even with the best intentions, is not always quite infallible.

WE do not all regret the stern necessity which compelled us to leave over our description of Mr. Mordey's machine till this week. It has given us an opportunity of making some comments thereon, and it will be seen that Mr. Rankin Kennedy has something to say upon the same subject. The apparatus has certainly created some little stir in the electrical world, although much which appears absolutely novel at first sight, gradually resolves itself into something which one remembers to have seen years ago. Still, when we look back upon the obsolete Lontin alternating current dynamo, with its fixed armature and revolving field magnets, we feel that things are managed differently now-a-days.

THE fire which we are informed took place at the Gaiety Theatre a fortnight or so since seems to have been a somewhat serious affair, and the mishap appears likely to affect the working of other theatres. Somehow it seems that at another place of entertainment, supplied with current from the Grosvenor Gallery, a rival contractor has been called in to report upon the installation, and to advise the proprietors who, we believe, had worried themselves into a deplorable state of fright. This, to us, is a matter of some surprise, and we feel that a protest should certainly be made against the growing practice of calling in rival firms to report upon one another's work, not that we really think the majority of them would care to undertake such an ungracious task. Such matters should be left to consulting engineers who are known to be free from any interest in advocating any one system to the prejudice of others.

WE clipped the following from Wednesday's *Standard*:—"The Belgian National Society of the Red Cross have conferred the honour of membership, with the Cross of Merit, upon Mr. C. B. Harness. Mr. Harness has also recently been elected President of the British Association of Medical Electricians, and is a member of the National Electric Medical Association." We congratulate the "eminent medical electrician" on the honours which other countries, as well as our own, have seen fit to confer upon him for the services he has rendered to suffering humanity. But who originated and started the British Association of Medical Electricians, and who elected Mr. Harness as president? What kind of corporate body is the National Electric Medical Association, and what connection had he of electropatic belt fame with its origin? The members of the Belgian National Society of the Red Cross should feel highly honoured by the latest addition to their ranks, and a proper degree of pride at being privileged to rub shoulders with Mr. C. B. Harness. Such an honour certainly occurs but once in a man's lifetime, and one should in no way run the risk of missing such a chance.

ON DEATH BY THE ELECTRIC CURRENT.*

By Prof. E. J. HOUSTON.

SEVERAL cases of death have resulted from incautious or accidental touching or handling of the wires employed in carrying the currents used in electric lighting. It becomes, therefore, a matter of great importance to inquire into some of the peculiarities of such accidents.

Death has resulted from the incautious handling or accidental contact both with the direct and with the alternating current.

In the case of the direct current, death results sometimes from shock, but generally, it would appear, from an electrolytic effect on the blood or other tissues of the body. The gaseous products arising from the decomposition possibly may, in some cases, be carried by the blood to the heart and thus stop its action, or, as probably occurs in most cases, death may probably result from electrolytic changes produced in the blood itself, or in other tissues. Death by the alternating current probably results from shock only. Resuscitation in cases of apparent death are more frequent with the alternating current than with the direct, most probably from the absence of actual electrolytic decomposition of the tissues.

Considerable surprise has often been manifested because certain currents that, in some instances, have been handled with impunity, in other cases have caused death. A current of a certain number of ampères, and of a certain difference of potential between the points touched, caused death in one case, while in another case with the same current strength in the line, two or three times the difference of potential between the points touched was received with impunity.

Making due allowance for differences in vitality, or in the condition of the heart-power of the subject, I think the following explanation will throw light on many of these cases. I offer it, however, mainly, though not entirely, from a theoretical standpoint.

The explanation would appear to be found in the portions of the body at which the current enters and passes out, which would, of course, necessarily be influenced by the position of the person receiving the discharge. Nearly all fatal or severe shocks occur from the lines being accidentally grounded at some point. The person then either deliberately touches, or is accidentally brought into contact with the line at some other point. Under these conditions, the electricity either passes into or out of the body at the feet. The greater or less probability of serious results will depend on the parts of the body through which the current passes. When any part of the body is placed in the path of an electric discharge, more of the discharge will pass through the better conductors, which perhaps will, generally, be the great nerve trunks and the muscles. Reference must, therefore, be had to the position of such nerve centres, as well as to the heart, the lungs and the viscera and other vital organs. The following contacts are among the most common :

(1) At the head. This contact is apt to be among the most dangerous, as the discharge in all probability takes place through some of the vital organs, such as the brain, the upper part of the spinal cord, or through some of the organs in the abdominal cavity or their principal nerves.

(2) At the shoulders. This is probably somewhat less dangerous than the preceding, as the brain is not in the path of the direct discharge. The vicinity of the upper part of the spinal cord is, however, very dangerous.

(3) At one of the hands. If the person is standing on both feet, this may be fatal, since the organs of the abdominal cavity and its nerve centres are in the path of the discharge. If the person is standing on one foot, then if this foot be on the same side of the body as the hand that is touched, the discharge will probably not be fatal, since the discharge does not necessarily pass through the organs of the abdominal cavity. If, however, the foot on which the person is standing be on the other side of the body from the hand that touches the wire, that is, if the person be standing on the right foot and touches the wire with his left hand, the discharge, if powerful, is apt to be fatal, since the organs of the abdominal cavity and its nerves are necessarily in the path of the discharge.

(4) On the back, especially in the upper portion. This is apt to be fatal, since the spinal cord is dangerously near the path of the discharge. The muscles of the back are also very large and would thus determine the passage of much of the current in this direction.

(5) Discharges ensuing on touching the wires with each hand are apt to be fatal, since the heart lies in the path of the current.

Those exposed to electric discharges would be protected from the effects of accidental grounding of the conductors, by wearing plates or discs of any high insulating material on the soles of the shoes, or inside the same.

Death by lightning probably results from the effects of shock, combined with those of electrolysis. In discharges of such enormous difference of potential as exists in lightning, disruptive effects may also be produced.

The almost instantaneous and consequently painless nature of death by the electric shock has, as is well known, led to the suggestion that it be employed in public executions in place of hanging or decapitation. Should such suggestion be adopted, the character of the apparatus employed should be such as to cause death by shock, followed, to avoid the possibility of resuscitation, in case of apparent death, by the passage of an electrolysing current.

* Abstract Proc. Amer. Phllos. Society.

A NEW ALTERNATING CURRENT DYNAMO.

WE illustrate below the alternating current machine designed by Mr. Mordey and referred to in our note of last week. Alternating current machines may be divided into two classes, those with fixed field magnets and revolving armature and those with fixed armature and revolving magnets. The dynamo now described belongs to the latter class. At a speed of 650 revolutions per minute this machine gives

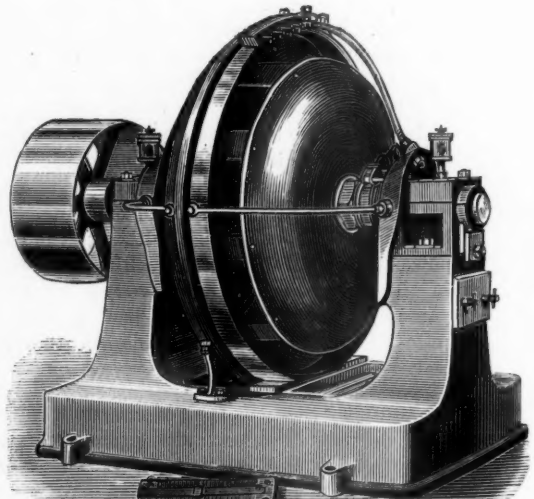


FIG. 1.—MORDEY ALTERNATOR.

40,000 watts, the terminal difference of potentials being 2,000 volts.

Fig. 2 shows the armature, which is stationary, consisting of a number of coils of narrow copper ribbon, wound on cores of non-conducting material. Each coil is bolted at the broad end between two brackets, the ends of the conductor being brought out through porcelain insulators. The brackets are bolted to a gun-metal supporting ring, the coils

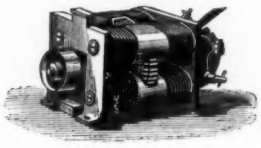


FIG. 1A.—VICTORIA EXCITER.

being thus rigidly and securely held in position by metal supports, which in no part come between the poles, and which are, in fact, almost entirely out of the magnetic field. By this means eddy currents are almost entirely avoided, any loss from these being still further reduced by the use of German silver for the brackets and bolts, the high resistance of this alloy preventing the generation of local currents, of more than small magnitude. The gun metal supporting ring, which is bolted to the bed plate of the machine, is in two portions, being divided in a vertical diametrical line. These two parts, after having received the coils, are bolted together and to the bed plate, the field magnet being first placed in

FIG 2.—ARMATURE OF ALTERNATOR.

position. This design provides ample facilities for repairs. It allows not only of single armature coils being quickly removed and replaced, but also renders it easy to take out one half or the whole of the armature. It is of the first importance in all electric lighting work, especially in central stations, that the machinery should be planned not only with a view to prevention of breakdown, but also to permit of any necessary repairs being quickly carried out. It will be seen that in this armature both these ends have been satisfactorily attained.

So far there is no special feature in the design of the armature, the novelty lying in the construction of the field magnet. This is a single electro-magnet consisting of an iron cylinder through which passes the shaft and on which is wound the exciting coil, fig. 3. Against each end of the cylinder is placed a cast iron piece having nine horns or spokes radiating from the centre and bent over so that the polar faces approach closely to each other, leaving between them only the small gap shown. There are thus nine south poles on one side of the gap facing nine north poles on the other, and between these poles is held the armature, the entire field magnet revolving with the shaft on which it is mounted. The ends of the exciting coil are connected to collector rings on the shaft shown to the right in fig. 3.

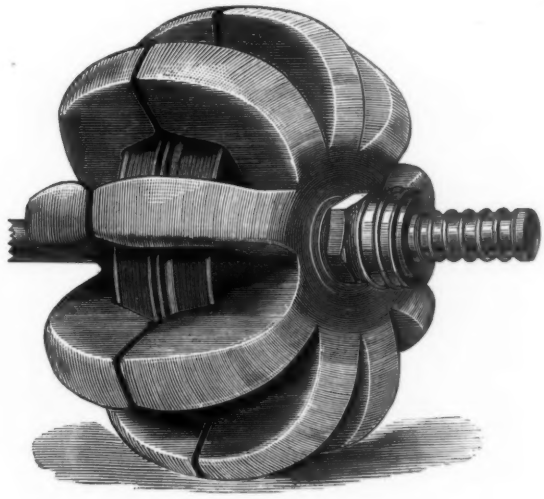


FIG. 3.—FIELD MAGNET OF ALTERNATOR.

It will be observed that this form of field magnet is of a simple character. A single exciting coil suffices for a machine of any size, speed, or number of alternations. Besides its peculiarity of form it differs from the usual arrangement in that it has poles of one sign only on each side of the armature, the magnetic leakage between adjacent poles on each side being absolutely nil, a condition widely different from that of machines having the usual arrangement of alternate polarities. In the Ferranti machine, for example, where the armature has no iron and rotates in a gap somewhat similar to that here described, about 50 per cent. of the total lines of force pass between the adjacent magnets, never reaching the armature at all. On the other hand, it must be remembered that where iron is employed for an armature core the leakage is very much smaller, being probably not more than 25 per cent., if so much. The chief advantage in the construction appears to be gained from the simple, and therefore inexpensive form of magnet employed, and not from any increased output for a given weight. Indeed, it appears to be rather a weighty type of machine, this being of no importance, however, provided its weight does not make it costly.

By revolving the field magnet instead of the armature, steadiness of running is secured, the heavy magnet acting as an excellent flywheel, and effectually neutralising any pulsation due to irregularity in the stroke of the engine. This is a point of some importance where slow speed engines are used. Further, as the parts revolving at the highest velocity are simple solid iron masses of the strongest description, not subject to heating, and having no copper wire to expand and fly out, the electrical and mechanical considerations, which in ordinary dynamos usually render slow speed advisable, do not here apply. The armature being stationary the coils have to be supported only with a view to resisting the drag of the field.

The Mordey alternator is shown in its complete form in fig. 1. The field magnet is almost entirely hidden

by sheet metal covers, which have for their object the prevention of air disturbance by the horns. The armature terminals, which are not seen in the figure, are at the upper part of the supporting ring. The thrust bearing is adjustable longitudinally for the purpose of enabling the field to be placed exactly symmetrical with regard to the armature. The alternator is very nearly self-regulating in itself, as is shown by fig. 4, which is the characteristic of the machine throughout a range of 37,000 watts. From this curve it is clear that a large proportion of the load might safely be turned off without danger to any remaining lamps, or that a large proportion could be turned off without attracting notice on the rest of the circuit. It is, therefore, not considered necessary or desirable, except under special circumstances, to provide other than a simple hand regulation at the dynamo for the

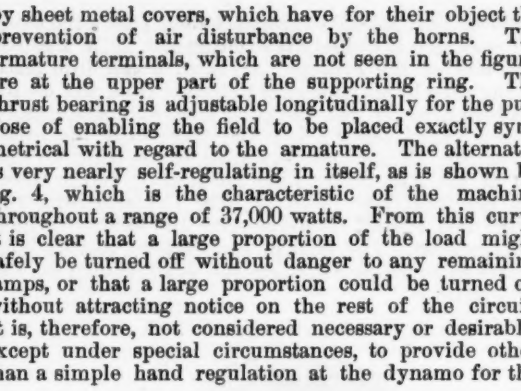


FIG. 4.—CHARACTERISTIC OF MORDEY ALTERNATOR.

purpose of controlling the potential difference. Sudden and violent fluctuations of the lights are impossible with this machine, and an occasional touch of the resistance regulator as the load comes on or off meets all practical requirements. It is only in the case of machines whose potential curve is a rapidly falling one that it is necessary to resort to automatic control. There is no doubt that by avoiding the use of additional apparatus of this sort the chances of temporary interruption are reduced. The small Victoria dynamo, used as exciter, is shown by fig. 1A, which is to the same scale as the alternator.

By the arrangement of the armature coils it is easy to obtain various combinations if desired. This circumstance is made use of for simplifying the measurement of the potential. Instead of taking the reading across the terminals, which would necessitate the use of an electrometer or a very high resistance voltmeter, an ordinary voltmeter indicating to 100 or 150 volts is placed across one of the coils, the machine being fitted with a special pair of voltmeter terminals for this purpose. The indication thus obtained, multiplied by the total number of armature coils, gives the potential difference between the armature terminals. The voltmeter may, if desired, have its dial marked to directly indicate the total potential difference.

The Proposed Electric Tramcars for Leamington.—The announcement of the intention to run electrical tramcars on the Warwick and Leamington Tramway is exciting considerable public interest in the locality. It is said that the Julien system is to be adopted, and as soon as the necessary permission has been obtained from the several local authorities through whose districts the tramway runs, arrangements will be made for the introduction of one car for experimental purposes. The tramway line has some steep gradients.

NOTES ON ELECTRICAL AMERICA.

BY J. SWINBURNE AND R. P. SELLON.

(*Concluded from page* 571.)

THERE is a good deal of central station work coming on at Boston. The new Edison station is very fine. This is all underground conductor work. The practice of the Edison Company is so well known in this country that no description is necessary. Their method of dealing with short circuits is truly American, however. If we had short circuits between two underground mains, we would probably disconnect that part of the circuit and go and examine it with a detector and an aged Leclanché cell. The American practice is to switch all the machines in the station on it and burn it out.

The American ideas as to measuring-instruments are very crude. Most of our electrical engineers have very odd notions of accuracy in measurement, though things are getting better now, but in the States they seem to have no idea at all. The Edison people take more trouble about measurement than others, but they go to work in a roundabout and complicated way. One form of voltmeter, for instance, consists of a Wheatstone bridge with a red hot lamp in one limb. When the E.M.F. on this system varies, the resistance of the lamp varies too, and when the balance is obtained the E.M.F. is right. Others compare the E.M.F. to be measured with a little Daniell cell mounted in the instrument.

Motors are, of course, very much more extensively used in America. The turn out of Sprague motors is something enormous. On many stations they use Edison dynamos and Sprague motors. This is probably a survival of the old theory that a motor should be different in design from a dynamo.

Of course, running through a few of the Eastern States is not seeing electrical America; there is probably much greater activity in the West, at any rate in installation work.

Finally, our impression is that though there is a great deal to see there, we have nothing to learn in the States, and Americans have nothing to learn from us. The differences in practice are due to differences in circumstances, not to our being too scientific or to their being too much guided by rule of thumb. The idea that we are, as a rule, more scientific than the Americans seems to be erroneous. It probably arises from several causes. In the first place, the Americans have not our absurd reverence for mathematical symbols. In England, anyone who drags in a lot of mathematical expressions is regarded as an authority, whether his mathematics are properly applied or not. Endless calculations on empirical formulæ, or on data assumed so as to admit of mathematical treatment, carry no weight on the other side of the water.

On the other hand, American engineers understand their subject just as well as we do. There are also many good mathematicians amongst them. American engineers are more modest than we are. It is not necessary to go to America to see this. A glance at any of the discussions at electric societies there will show this. If Prof. John P. So-and-So cannot grasp some theoretical or practical point, he gets up and says he does not understand it, and would like it explained. An English electrician never speaks except to enlighten the world, from a superior standpoint, and would rather give vent to a string of mixed mathematics, admitting of no practical application, than ask a question which would expose any ignorance on a theoretical point.

Most of the advance in America is due to the enormous development of new towns. Gas is always dear, generally costing two or three times what it does in England. We are told that the English are too Conservative to take up electric lighting, but this is probably not the result of any peculiar disposition of the English people, but is due to the fact that this country is developed and settled down, whereas America is still to some extent in a transition state. The same Con-

servatism or slowness is to be noticed on the Continent, though in some cases they are more go-ahead there. People say it is wonderful that America in a century has made as much progress in civilisation as the old world has in a thousand years. This is a perversion of the facts. America started afresh with all the knowledge gained from Old World experience, but without the legacy due to its past blunders. It ought, therefore, to be infinitely ahead of us in all directions. But, on the other hand, the consciousness of past blunders and the continual presence of the results make us careful—perhaps, too careful—about making experiments. The American is like a boy who has obtained all the knowledge of the past from books, and goes rashly into anything new until bitter experience makes him more cautious. Perhaps, on the whole, the rashness of the well-informed boy is preferable to the caution of the old man. On that we offer no opinion; we merely wish to show that the go-ahead qualities of the American are the results of circumstances and not of some difference in the cerebrum.

In electric lighting there is also a great deal due to the completely different practice. In the States nearly all electric light work is central station work. The result is that a maker of machinery makes his machines wholesale, one a counterpart of another. This might also be necessary in the States on account of the high price of labour. In England a maker hardly turns out two machines alike, as he deals with a multitude of small customers. One wants 97 volts and 305 ampères at 113 revolutions, and the next wants 94·5 volts and 317 ampères at 109 revolutions and an extraordinary lubricating arrangement of his own invention, and a new machine must be made for him. The American works seem to be better managed than ours. The inventor or designer is not mixed up with the manufacture as he is in this country. It is the business of one man to design, and when his design is complete and perfected it is handed over to the superintendent to make in large numbers, and the designer has nothing further to do with it. In this country in dealing with electrical firms you feel as if you were dealing with amateurs with little or no business experience. In very many cases the men are under people who have never had charge of men before; the business is in the hands of people with no outside business experience, and goods are never supplied to time, and letters are answered in an amateur fashion a month late. This sort of thing is dying out now, but not very quickly. It is quite different in America: the electrical work is done by electrical men, and the business part is controlled by business men of knowledge and experience who have their own affairs entirely under their own control.

By the way, the title of this paper is badly chosen, as we refer to electric lighting only. There are some telephones and telegraphs in America too.

REPORT ON A PROJECTED CENTRAL STATION IN COLOGNE.

By A. HEGENER, Manager of the Gas and Water Works.

SINCE the year 1878, when the Paris Exhibition brought the electric light for the first time into view on the large practical scale, the question whether, and to what extent, this light ought to be rendered available to the community of Cologne through the town undertaking the supply has been often considered, cleared up by several preliminary investigations, and the solution of it been brought nearer.

The following conclusions may be stated:—1. Electric light has incontestably some advantages, especially salubrity and freedom from fire risks. 2. Progress in electric lighting has been such that there are now various systems by which a whole town may be lit up. 3. For this light to go on securely, the apparatus must be most carefully planned, perfectly carried out, provided with ample reserves, and must be always driven with painstaking attention. 4. Electric light is in all cases, where some special natural resource does not intervene to make the case exceptional, dearer than gas at German—and all the more at Cologne—prices. 5. The electric light is now, as formerly, rather a light *de luxe*, the use of which will be appropriate in certain cases. 6. It is incorrect to supply this luxury at cost price, or even less, while the competing gas is made a source of revenue. 7. Should the town resolve upon a large electric lighting undertaking, it must deal only with the firms of greatest experience in connection with such undertakings.

The preceding statements should be briefly discussed. Where "electric light" is mentioned, glow lamp light is understood, unless the arc light be specially named.

Advantages of the Electric Light.—Glow lamps cannot kindle near objects as open flames may; they throw no products of combustion into the atmosphere: even arc lamps, for the light they yield, give very little heat and little combustion product; the small quantity of nitric acid which they produce is of no importance. Electric wires are not, like gas pipes, possible sources of poison. On the other hand, it must not be supposed that the introduction of the electric light will remove all dangers. Glow lamps may modify the atmosphere, and produce less heat, but at the same time they possess less ventilating power; an ill-ventilated room with glow lamps and persons in it becomes poisonous after a while. Again, when alternating currents of high tension with transformers are distributed with unprotected wires about a house, there is danger to life; about the streets also, such arrangements should never be employed except with well insulated cables. Then there arises the question, what ill effect such high tension alternating currents may have on neighbouring telegraph and, especially, telephone wires. All electric conductors within doors must be laid with thorough care, well insulated, and arranged in view of possible accident; otherwise, even with low tension currents, there may be danger of fire. The question of colour may be alluded to. The arc light has, during recent years, been unjustifiably neglected, and any scheme for supplying a town with the electric light ought to be such that arc lamps can be used at any point.

Lighting of Town Areas.—Examples: New York, Berlin, Milan. The central station may be in the district supplied, or may be at some distance: the former is better, especially if the station be in the centre of the district supplied—there being then the least loss in power and tension, so that low tension currents may more readily be used and the danger of high tension currents avoided.

The case is different when there is available, at a distant point, a source of power, say a waterfall; or when the cost of land in the district to be lighted is prohibitory or the conduct of an electric lighting station would be a source of nuisance or danger. Water power is not in the question at Cologne: the price of land within the district is a serious item. Heavy machinery within a populous city is not specially agreeable—on the contrary, the effort always is to get it, as far as possible, outside; but some of the objections to machinery in towns are not insuperable; the smoke nuisance has been overcome by the Berlin Städtische Elektricitätswerke, the Edison Company (Friedrichstr, Berlin) and others, with the best results in actual practice. Proper choice of fuel—even at a somewhat higher price—sufficiently large steam boilers, good stoking and service, are the only, and the sufficient means. If gas motors be used there is no question of smoke.

Disturbance through the noise of the machinery is often a cause of complaint on the part of the neighbours. In Dijon it was necessary, at considerable loss, to remove the Edison machine station out of the town, and to get up a new system with transformers. This was on account of the annoyance produced by the noise

(*La Lumière Electrique*, 14th May, 1887). Similar complaints are reported from other towns. They may, in great part, be provided against by laying the machine beds on very deep foundations, isolated from surrounding buildings; and the machine area must be large enough to keep the machinery at a sufficient distance from the neighbouring houses.

When in these respects the possibility of a central station, either within or outside the district, is recognised, there comes up for consideration another difference between gas and electric lighting. Gas lighting finds an advantage in the fullest possible centralisation, and to set up separate gas works for separate houses, or groups of houses, would be out of the question; thus gasmaking becomes a virtual monopoly, while an electric undertaking can reckon on no such monopoly. In each house there may be a gas engine and a dynamo. This feature of electric lighting even affects those gas undertakings which have a monopoly of the use of the streets, and would not cease to act upon a central electric undertaking. True, it need not be expected that a great many householders would lay out money in electrical apparatus if they could get their electricity in from outside; and specially so in rented houses; it is not every tenant who would be disposed to use the electric light; and if he did not, the machinery would depreciate rapidly.

Necessary conditions of a Central Station.—It is assumed that the central electric station is to compete with the gasworks. That being so, then

(*a*) The arrangement must be such that every citizen shall have the right and the opportunity of using the electric light on fulfilling the necessary conditions.

(*b*) The light must be at command both night and day.

(*c*) The guaranteed lighting power must be kept up.

(*d*) The constancy of action must be insured by ample reserves of machinery and fittings.

(*e*) The conduct of the undertaking must be free from danger to life or health.

(*f*) The cost must be as low as possible.

As to the first of these conditions (*a*), it happens here and there that even with gas lighting a house stands remote, and has to go without gas supply for a time; but in comparison with electric lighting (which has, as yet, only been able to establish itself in the densest and best areas of rich and busy towns) gas lighting may be considered as covering the whole ground. Electric light cannot become a competitor to gas on these terms without endangering or ending its own existence; but the lighting requirements in a densely built and populated business street are plainly different from those of an outlying thinly-populated district; then, just as noiseless wood or asphalt pavement is used in the former, while common pavement is used in the latter, so the more expensive light may be used in the former if required and paid for.

[Here follows a description of the part of Cologne considered most suitable as an electric lighting district; number of gas jets, 105,885; average consumption, 5,200 cubic feet per burner: number of burners in rest of Cologne, 73,215; average consumption, 3,440 cubic feet per burner per annum; radius of district from central station, 550 yards.]

(*b*) The uninterrupted run of the electric light is, in many cases, not necessary in order to insure its use. The unfavourable periods may be turned over to the gasworks. A diagram shows that in Cologne the demand for gas varies from one to twenty. What significance this has for the electric light, how great a loss there is of current and of power when the demand is slack, may be readily judged. An uninterrupted run would be best secured by gas motors during the day and steam engines at night.

(*c*) The guaranteed lighting power should not be allowed to fall off. Gasworks can, at a push, supply more light than ordinary; electric works cannot push the light, especially with glow lamps. If the tension of the current be, so far as practicable, the same throughout, and be correctly adjusted, the life of the lamp varies inversely with its brilliancy. If the lamp be overdriven it blackens its bulb, and the glowing filament becomes split up (W. Siemens), and has, even with the same current, a lower temperature and lighting power, so that after 800 hours the lighting power has sunk to half, or even less. The newer Siemens lamps lose much less than this, and when they fall off in lighting power absorb less energy in almost an equal proportion. The best lamps should be used, and renewed at an earlier stage than hitherto. As to the current's intensity, it should not be allowed to vary more than $1\frac{1}{2}$ per cent. That means a change of 1-candle lighting power.

(*d*) Reserve apparatus, &c. One horse-power = 736 volt-ampères, of which 70 per cent. are used in the lamps. The 16-candle lamp uses 55 volt-ampères. If we reckon that all the lamps are in use, and no reserve, then $\frac{736 \times \cdot 70}{55} = 9{\cdot}4$ lamps per horse-power. If we allow 25 per cent. reserve, we are brought to 7·5 lamps per horse-power. If we suppose 25 per cent. reserve, and not more than four-fifths of the lamps in use at any one time, the number 9·4 lamps per horse-power is restored. As to *accumulators*, these would probably, if they were reliable and cheap enough, form the best kind of reserve. As yet, unhappily, they have not given such results as to entitle them to recommendation.

(*e*). To the danger to life or health we have already alluded. It is not surprising that the advocates of electric lighting here and there exaggerate its merits; but that the modern apostles of hygiene should attack gas lighting seems peculiar. Dr. Alexander Sudakoff, in the "Archiv für Hygiene" (Band 5, Heft 2, 1886), published a paper criticising Professor Pettenkofer's researches on the flow of gas through earth towards inhabited rooms, and took occasion to say: "The manufacture of coal gas is at present, at least on the Continent, beyond the control of the public sanitary authorities. The gas technicians who manage gas works make gas of the worst quality, so that it may be made at the least expense, without attending in any case to the interests of the consumer, &c." Every one who has any information on the subject knows that this requires no answer; and it was reserved for the German Press to discover that the writer was an authority upon gas matters.

Electric light needs to be supplemented by efficient means of ventilation in crowded rooms; and it is by no means absolutely safe, as many instances now show. If people would cease neglecting ventilating fittings when they build houses, and would use the necessary discipline in theatre management, gas would be in both respects quite suitable, free from danger either to life or health.

Cost of the Electric Light.—One thousand cubic feet of Cologne gas cost in 1886–87 $35\frac{3}{4}$d. The light yielded was 12·4 candles for 6 cubic feet per hour; therefore 16-candle light would cost at the rate of 0·177d. per hour; the candles being the English standard and the lamp a Dumas argand.

The cost of the electric light needs calculation. The chief question is, what percentage should be allowed for sinking fund and depreciation, and another is, what number of hours light per annum should be estimated? If 15 per cent. be allowed on capital (interest only for land), and 730 hours per annum per lamp, the price per lamp per hour works out at 0·72d. Some will say 15 per cent. is too high and 730 hours too low. It is better to turn to the results of actual working.

The balance sheet of the Berlin Städtische Elektricitätswerk for 1886-87 showed a profit of £48 14s. 6d. Among the receipts there figured £1,915 for interest and £2,637 for installation profits, &c. The proper receipts for current came only to £3,547, against which were £3,002 trade expenses. The figures show, when carefully examined, that the works are not yet fully utilised or in full run, and improvement may be expected on that score. The 16-candle lamp costs the consumer 0·48d. per hour, to which has to be added a lamp-due of 6s. per year. The average is thus about 0·6d. per hour, a price which appears decidedly insufficient to provide the electric light even for the centre of the greatest and busiest town in Germany.

The Società Generale Italiana di Elettricità, in Milan, divided, for 1886, 2⅘ per cent. after comparatively small deductions and an incomparably high price for arc lighting. In the previous year the dividend was 1·6 per cent. Both the works here cited are well known to be well managed, and are under the special care of the Edison Companies. Not in mismanagement but in too low a price do we find the reason of their want of profit. It is unfortunate that after these examples no attempt has been made in any other German town to go on the basis of charging a sufficient price. But without this, no one will undertake to supply the electric light as a source of profit: it can only be supplied as a luxury. These things being so, and being well known, it is wonderful that prices which are too low are everywhere being taken, and that there is so much ignorance as to the relative costs of gas light and the electric light.

In the "Fortschritt der Elektrotechnik" (1887, p. 105) Dr. Karl Strecker writes to controvert the report of the Berlin Town Gasworks, according to which report the electric light is from six to seven times dearer than gas. He says the price of electric light at central stations is 0·48d. without farther cost (interest of fittings, meter rent, &c.), while gas lighting costs about 0·36d. Let us assume, in reply, that Dr. Strecker's figures are correct; the electric light at 0·48d. can make a profit of £48 14s. 6d., while gas at 0·36d. can make one of £371,020 5s. 4d. It is obvious that if the electric light is to give a proportionate profit its price will have to be higher.

One may go still further. The existing electrical establishments have had to spend much money in experimental work to enable them to make money ultimately. On the other hand, they have supplied machines and conductors cheaply. Prices must go up, for all industries are now at their lowest; and the rise of 100 per cent. in the price of copper will occur to the minds of all. The price of all materials will go up, and there will be no possibilities of compensation from bye-products. Briefly, all considerations lead to the conclusion that electric light, not only will not become cheaper than it is (in Berlin), but must become substantially dearer. Gas burner against glow lamp, at Cologne prices, the electric light is now four times the price of gas.

The Electric Light a Luxury.—As such, when rightly named, it has its rightful place. The private consumer can judge for himself whether he will indulge in it or not. The question as to its use in public buildings is more difficult. In rarely-used halls it comes very dear: the Vienna Rath-haus is a frightful example of this, for the 16-candle lamp comes to 1½d. per hour, or six times the cost of Vienna gas with highly efficient lamps. In this case, however, a great deal of the blame for the high cost is laid upon the machinery; certainly gas motors ought to have been used in the Vienna Rathhaus, if anywhere. Electric light should be charged on the same principles as gas. If gas be a source of profit, electric light should not be sold at or below cost: the consequence may be disturbance of trade by throwing on the rates any consequent loss on the gas, or by raising the price of gas itself, for the area of good gas consumers has been given away without profit to the rival light.

Briefly, if the electric light be introduced, the prices must be so adjusted from the beginning as to make both systems bear the same burdens and yield proportionate profits; and, again, the best possible installation must be arranged for and provided, necessarily by an experienced firm: of such firms there are not many.

In an installation of this kind, about one-third of the expense is due to the specifically electrical machines and apparatus, two-thirds to the machinery, buildings, and careful fitting up: and all parts must be placed in thoroughly competent hands, else some such experience as that of the Vienna Opera may be repeated. There the adoption of a boiler of unsuitable construction, and the use of unsuitable water, caused very grievous results, for which the conductors (especially in the interior of the hall), the number and arrangements of the lamps, and the accumulators, are also blamed. Such blunders can and must be avoided.

[The report ends with a sketch of the suggested agreement to be signed by the consumer. We note the suggested period of five years agreement to be made with landlord, not with tenant; after five years a quarter's notice; consumer not to meddle, and to permit access; price, 6 pf. (= 0·72d.) per 16-candle lamp per hour, each lamp to be charged a minimum of 500 hours, whether it be used or not.]—*Journal für Gasbeleuchtung*, 1888, Nos. 7 and 8.

THE EFFICIENCY OF INCANDESCENT LAMPS WITH DIRECT AND ALTERNATING CURRENTS.*

By W. E. AYRTON and JOHN PERRY.

IT is now well understood that in order to economically distribute power by means of electricity it is necessary to employ a high potential difference, or P.D., between the mains and a small current flowing through them, while considerations of safety require that the P.D. between the leads in the houses shall not exceed 100 or 200 volts. Hence some system of converting a large P.D. and a small current into a small P.D., and a large current has to be employed, and the four systems of conversion that have hitherto been devised consist in the employment of:—1. Motor-dynamos; 2. Accumulators; 3. Alternating current transformers: 4. Direct current transformers.

Of these four methods the third is the one that is most extensively utilised at the present time, indeed it is the only system of conversion that is at all extensively used, at any rate in this country. But in view of some direct current system of conversion coming also into common use, there arises a question of considerable importance to the consumer, viz., is more light obtained with the same expenditure of power with direct or alternating currents? And, apart from considerations of the electric distribution of power on a large scale, the answer to this question is of importance in supplying one factor towards the decision as to the relative advantages and disadvantages of direct and alternating currents for detached installations.

Where the electric energy supplied to a consumer has been charged by meter, people have, as a rule, been content to measure only the number of coulombs supplied, ignoring altogether any variation in the volts; but as electricity, *per se*, apart from the P.D., is of no commercial value whatever, and, therefore, is unlike water apart from pressure, it is clear that in estimating the value of a supply of electric energy for lighting purposes we must measure the watts and not merely the current. The problem, therefore, that we have attempted to solve is whether a Board of Trade unit (1,000 watt hours) is more valuable for lighting by incandescent lamps when the current is direct or when the current is alternating.

For a complete solution of the problem we must ascertain not merely the "efficiency of the lamp" or the number of candles per watt with the two systems of supply, but also the life of the lamp, since the cost of lamp renewals may be as important a question for the consumer as the bill for electric power. Unfortunately, however, there does not exist, as far as we are aware, any accurate information as to the life of an incandescent lamp with various alternating P.Ds., indeed the data at our disposal for the life of a lamp with various non-alternating P.Ds. is most meagre. And if any member of the society can supply us with information regarding the life of some fixed type of incandescent lamp, either with different direct P.Ds. or with different alternating P.Ds., we shall be grateful for the information, as it will furnish us with a further opportunity of using the method described in our paper read before this society for deciding "On the Most Economical Potential Difference to Employ with Incandescent Lamps."†

For the present, therefore, we shall confine ourselves solely to the question of efficiency, and as it is known that the efficiency of an incandescent lamp is increased with the current passing through the lamp, it is clear that to obtain an accurate comparison of the efficiency with direct and alternating currents, we must employ exactly the same current in both cases ,or rather the same mean square of the current, for this will be most likely to develop the same rate of production of heat in the lamp, since this rate is proportional to the resistance into the mean square of the current, whether the current be direct or alternating. We say most likely, because it must not be assumed without experimental proof that the resistance of a filament is exactly the same for the same mean square of current whether that current be direct or alternating.

Some writers have stated that the current, as measured by an electro-dynamometer, required to be sent through an incandescent lamp, when emitting a definite amount of light, had a different value when the current was an alternating one from what it had when the current was direct. This difference might be due either to a defect in the dynamometer measurement or to some variation

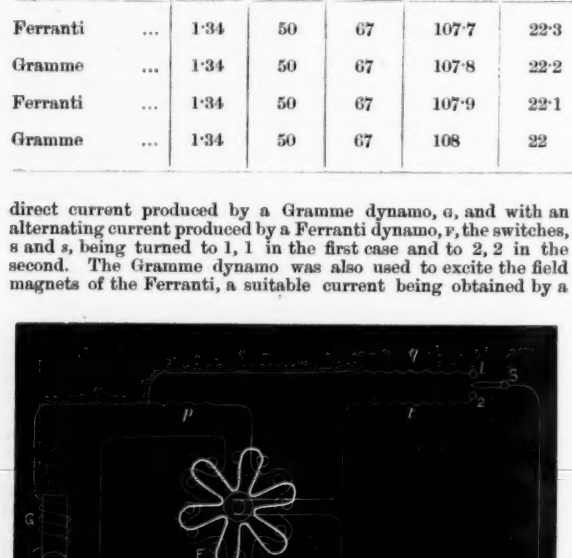
* Read at the Physical Society of London.
† Phil. Mag., April, 1885.

in the light standard. If the wire with which the dynamometer is wound be thick, then the current density may be far from uniform when the current is alternating, and on this account, as observed by Captain Cardew some years ago, a dynamometer might give different readings for different rates of alternation of the current, while an incandescent lamp in circuit with it remained equally bright.

To avoid this possible source of error the dynamometer, which was constructed by Messrs. Shepherd, Vignoles, and Wheatley, the three of the students of the Central Institution who carried out the investigation, was wound with much finer wire than would usually be employed in the construction of a dynamometer not required to read currents much below 1 ampère. The dynamometer was for that reason unnecessarily sensitive, and it required a fairly strong spring to control the motion of the suspended coil. This led to an unnecessary waste of energy in the dynamometer, but that was of no consequence in this investigation, as our object was to measure the mean square of the current most accurately, and not to satisfy the condition, which is of considerable importance in the design of commercial measuring instruments, of wasting as little energy as possible in the instruments.

To the suspended coil of the dynamometer was attached a mirror, and the values of the deflection of the spot of light were determined by direct comparison with the simultaneous readings of an accurately calibrated spring ammeter when various direct currents were successively sent through the circuit. The sensibility was such that a deflection of 400 scale divisions was produced on a scale 68·88 inches away for a current of 2·53 ampères, which corresponds with a deflection of 140 scale divisions for 1·5 ampères, which was about the usual current passing through the dynamometer in the actual lamp experiments. The values of the current could, therefore, be accurately measured by the dynamometer which is indicated by D in the figure, and then by knowing what fraction of the current passing through the dynamometer, D, passed through the non-inductive voltmeter, V, the current passing through the lamp is known.

Any error that might have arisen from a variation of the light standard was eliminated by taking successive readings with a direct current produced by a Gramme dynamo, G, and with an alternating current produced by a Ferranti dynamo, F, the switches, S and S, being turned to 1, 1 in the first case and to 2, 2 in the second. The Gramme dynamo was also used to excite the field magnets of the Ferranti, a suitable current being obtained by a proper adjustment of the resistance, p. By means of the resistances, q and t, the direct and alternating currents passing through the incandescent lamp, L, could be respectively varied, and it was found that if these resistances were so adjusted that the reading on the dynamometer, D, was the same in both cases, so also was the reading on the non-inductive voltmeter, V.



It is known that when power is supplied by means of an alternating current to a circuit of resistance, r, ohms and coefficient of self-induction, l, secohms that

$$\frac{\text{Number of true watts}}{\text{Number of measured watts}} = \frac{r\,\tau}{\sqrt{l^2\,\pi^2 + r^2\,\tau^2}}$$

where the measured watts were obtained by multiplying $\sqrt{A^2}$, the square root of the mean square of the ampères, as measured by the dynamometer by $\sqrt{v^2}$, the square root of the mean square of the volts, as measured by the non-inductive voltmeter, and where τ is the time between one alternation and the next, or half a complete period. Therefore, the number of true watts

$$= \frac{r\,\tau\,\sqrt{A^2}\,\sqrt{v^2}}{\sqrt{l^2\,\pi^2 + r^2\,\tau^2}}.$$

When in our case r and l are the resistance, and coefficient of self-induction of the carbon filament of the lamp. In the first set of experiments a lamp with a looped filament was employed, but the experiments seemed to indicate that the value of l was not quite small enough to make the term $l^2\,\pi^2$ absolutely negligible, or else that there was some slight mutual induction between the dynamometer coils and a small brass vessel containing oil, in which moved a damping vane attached to the moving coil. The results were therefore discarded and this vessel was removed and replaced with one made of non-conducting material, and all metal near the dynamometer was as far as possible removed. The lamps subsequently employed were first one with an M-shaped filament, and another with a simple horseshoe shaped filament, each possessing little self-induction.

The light was measured by comparison with a standard candle, the two being placed 130 centimetres apart on the photometer, P, and a screen composed of two pieces of paraffin wax, W, with silvered paper between them was adjusted until the two pieces of wax appeared equally bright, the comparison being first made when the screen was looked at through ruby-red glass and then through signal-green glass.

The following is a sample of the results obtained, a and b being the distances respectively of the screen from the incandescent lamp and from the standard candle.

TABLE I.

				Green.				Red.			
	$\sqrt{A^2}$	$\sqrt{v^2}$	Watts.	a	b	Candles.	Watts per candle.	a	b	Candles.	Watts per candle.
Ferranti ...	1·34	50	67	107·7	22·3	23·33	2·872	106·5	23·5	20·52	3·265
Gramme ...	1·34	50	67	107·8	22·2	23·52	2·848	106·4	23·6	20·34	3·295
Ferranti ...	1·34	50	67	107·9	22·1	23·74	2·823	106	24	19·51	3·435
Gramme ...	1·34	50	67	108	22	24·11	2·779	105·9	24·1	19·32	3·469

It will be observed that in the set of four successive observations given in Table No. I. for green light the candle-power of the lamp appears to be steadily increasing, a result probably due to the brightness of the candle slowly diminishing, but although this would make the *absolute* determination of the efficiency of the incandescent lamp inexact, it introduces no error in the determination of the *relative* efficiences of the lamp with direct and alternating currents, since every observation with the direct current was immediately followed by one with alternating current, so that the means of all the corresponding direct current measurements may be safely compared with the means of all the alternating current measurements. Similarly for this investigation it is unimportant whether the standard candle used on one day was slightly more or less bright than the standard candle used on the following day. Further, since for any two successive observations with the same coloured light, with direct and with alternating current, the screen was at practically the same distance from the lamp, the fact that the rays of light coming from the lamp made a somewhat different angle with the surface of the paraffin wax from the angle made by the rays coming from the candle introduced no error in this investigation of *comparative* efficiencies, although it might very likely do so in an *absolute* determination of the efficiency of an incandescent lamp. In fact, the simple device of successively taking observations with direct and with alternating currents throughout the whole investigation, removed most of the objections that usually may be made against photometric determinations carried out with a candle as the standard of light.

Disregarding the experiments made with the lamp with the looped filament for the reason given above, Table II. gives the summary of the results obtained, and the conclusion to be drawn from them is that, although the watts per candle for green light are not quite the same for direct and for alternating currents, and although the watts per candle for red light are also not exactly the same for direct and alternating, still the difference between the results for the same colour is so small, that it may be put down to experimental errors, and this combined with the fact that the mean of all the 75 experiments gives practically the same number of watts per candle, for both direct and alternating currents leads to the practical certainty that *the efficiency of an incandescent lamp is the same for both direct and alternating currents.*

TABLE II.—MEAN VALUES OF

Lamp.	Number of Experiments made.	$\sqrt{A^2}$	$\sqrt{V^2}$	WATTS PER CANDLE. White Light.				Time of an alternation in seconds.
50-volt M shaped filament	20	1·25	50·5	Gramme. 3·053		Ferranti. 3·033		$\frac{1}{133}$
				Green Light.		Red Light.		
				Gramme.	Ferranti.	Gramme.	Ferranti.	
50-volt horse-shoe shaped filament	19	1·30	50	2·597	2·534	3·100	3·100	$\frac{1}{133}$
" " " "	20	1·34	50	2·935	2·966	3·254	3·164	$\frac{1}{107}$
" " " "	16	1·35	50	2·900	3·073	3·504	3·477	
Mean of the last three results ...	...	...	...	2·811	2·857	3·286	3·247	
Mean of all the 75 experiments ...	...	...	...	Gramme. 3·0490		Ferranti. 3·0497		

In all the experiments the plane of the filament was perpendicular to the screen.

EXETER AND THE ELECTRIC LIGHT.

AT a recent meeting of the Exeter Town Council, reported in our issue of May 18th, Mr. H. W. Michelmore, secretary of the Electric Light Company, applied for permission to carry wires across, and, if necessary, through the streets for the lighting of private houses and shops by electricity. This application was referred to the Streets Committee. At the meeting of the council last week this committee was "unable to recommend the Council to accede to the request in its present form." The surveyor had presented a report against the wires being carried overhead.

Mr. TOWNSEND moved that the Council give a general acceptance to the terms of Mr. Michelmore's letter, the same as was given to the telephone company. He stated that the application had nothing to do with street lighting. If the wires were carried underground there was a great risk of its imperfection, as had been evidenced in the town of Leamington.

Mr. BALE seconded the motion.

Mr. DUNN opposed the motion, on the ground that it was giving to this particular electric light company an advantage which would preclude other companies establishing themselves in the city of Exeter, thereby creating a monopoly which would be prejudicial to the best interests of the city. Further, he contended that they should delay giving this permission until the Council had dealt with the tenders which had been invited for the lighting of the public streets with electricity.

Mr. DAW said if this attempt to "rush" the matter through the Council were successful, he should immediately give notice of a motion to rescind.

Mr. WILSON said they wanted to get the best light for the citizens, and he supported the motion.

Mr. ANDREW said there was no question of expense, but it was an application from citizens to be allowed to supply themselves with the electric light, as they had asked previously for the telephone. The grave question in the case was whether the erection of those lines and wires in front of houses would be an inconvenience in restoring houses and in cases of fire.

The SURVEYOR replied that it would be an inconvenience but not an insurmountable difficulty when owners wanted to restore the fronts of their houses or in case of fire.

Mr. HEXTER, while he would like to see the electric light used in the city, objected to overhead wires as being unsightly, as well as dangerous, and thought the wires should be carried underground.

Mr. TOWNSEND consented to alter his motion to read that the application be granted, subject to the surveyor's approval in all respects, and that the approval be expressed by a formal agreement providing that the Council should have power at any time to withdraw their consent upon giving notice, and that thereupon the company should take down the poles and wires at the expiration of twelve months' notice.

Mr. WREFORD said there was an element of danger in suspended wires, as there was in most things, but the danger was small, and such as other towns had been ready to face.

Mr. HALL reminded the Mayor that if the question went to a vote and the members were equal he could not give the casting vote.

Mr. HUXTABLE said for the protection of the public the Council could not allow the wires to be placed overhead. In the emergency of a fire suspended wires would be dangerous, whilst at other times they would be an inconvenience to everybody.

Upon a division the resolution was carried by 16 to 10.

Mr. DAW said that on the ground that the report of the Committee, having just been issued, had not had fair consideration, he gave notice that at the next meeting he should move to rescind the resolution which had been passed.

Mr. HUXTABLE then moved, and Mr. STOCKHAM seconded, that the agreement with the company be determined at six months notice instead of twelve, as proposed.

On a division this proposal was lost.

At a later stage of the same meeting, the Special Committee on Electric Lighting recommended that tenders be invited by advertisement for lighting a specified area by means of the electric light, subject to the terms of the specification prepared by the surveyor, and to the stipulation of the Board of Trade.

Mr. TOWNSEND moved the adoption of the report, and said that when the tenders were received the Committee hoped to lay before the Council a report as to whether it was desirable to proceed further, or whether they should continue the present system of gas lighting.

Mr. JONES seconded the motion.

Mr. DUNN asked if there was a quorum present, as several members had left.

There were counted 19, which was an exact quorum.

Mr. DUNN said that to ask for tenders before the Council decided whether they would adopt electricity, was not treating the persons who went to the trouble and expense of tendering with proper consideration.

Mr. DAW (interposing) said he should save Mr. Dunn the trouble of speaking any longer by leaving the Chamber.

The MAYOR: There is another Councillor coming.

Mr. Hall, who had gone outside, was returning to his seat as Mr. Daw was leaving his. On learning, however, that the subject under discussion was a proposal to advertise for tenders for the electric light, he at once took up his hat and left again amid much laughter.

The Council then broke up for want of a quorum.

ON SOME EARLY FORMS OF ELECTRIC FURNACES.*

By Prof. EDWIN J. HOUSTON.

NAPIER'S ELECTRIC FURNACE.

NUMEROUS suggestions have been made at early dates for utilising the power of feeble electric currents in order to effect the reduction of various metallic ores. To accomplish this purpose the ores were dissolved by the action of suitable chemicals, and the electrolytic solutions thus obtained decomposed by the direct passage of the electric current.

In 1844, James Napier, of England, conceived the idea of preparing metallic ores, for the process of electric reduction, by heat in the place of chemical solution. This he accomplished by mixing the ores with certain fluxes and heating the mixtures to their point of fusion. The fused mass thus obtained was then subjected to the action of an electric current by the passage of which the reduction was effected.

The process suggested by Napier was a great advance over the purely chemical processes above referred to. Apart from the question of expense, the necessity for first obtaining a chemical solution of the ore to be treated, necessarily limited the class of reductions to which such a process is applicable. The comparative ease with which most ores can be reduced to the semi-fluid state by heating them in the presence of suitable fluxes is well known, and, where the electric resistance of such fluid masses is not great, the commercial practicability of the method proposed by Napier would appear to be assured.

* *Franklin Institute Journal.*

Napier's process, it will be seen, is not unlike the method adopted at a much earlier date by Davy in his great discovery of the metals of the alkaline earths.

In carrying out his invention, Napier mixes the ores to be reduced with the fluxes and places the mixtures in crucibles of refractory materials, such, for example, as plumbago. These crucibles are covered on the inside with clay, except at the bottom, which is left uncovered. By this means the electric current is caused to traverse the molten mass from the surface to the bottom of the crucible. The positive electrode of the decomposing battery is attached to an iron disc placed on the surface of the molten mass, while the negative electrode is connected with the outside of the crucible. Coke is sometimes used in place of the iron disc for this purpose.

Napier patented his furnace in England in 1844. His patent is numbered 10,362 of 1844, and is for "Improvements in treating mineral waters to obtain products therefrom, and for separating metals from other matters." Napier also took out letters patent in Great Britain, No. 10,684 of 1845, for the same invention, the specification of which is the same as in the preceding patent. This latter patent covered the British colonies and other territory not protected by his former patent.

The following description is taken from the specifications of the preceding patents.

"The second part of my invention has for its object the application to metalic ores when in a fused state of a current of electricity, so as to separate therefrom the metals which they contain.

"I will proceed to describe the method which I employ in the treatment of copper ores, though the invention is applicable to ores of other metals which are capable of being held in fusion with fluxes. I take a large crucible, or other convenient vessel, made of an electro-conducting material, those I have used being of plumbago (common black lead). The inside of this vessel I line all around with a lute of clay, except the bottom, which I leave uncovered. The luting should be very thin and laid on in two or three coats, drying slowly between each, so as to prevent cracking. When the vessel is sufficiently luted and dried, I put therein (with the usual fluxes) the regulus or calcined ore, which, when sulphurets are used, should have been well roasted so as to drive off as much as possible of the sulphur. I then place the vessel with its contents in an ordinary air furnace, keeping up the heat until the mass is in a state of fusion. In the meantime, I have prepared an ordinary voltaic battery of copper and amalgamated zinc charged with acidulated water, one part sulphuric acid to twenty-five parts water. To the positive wire of the battery, I attach an iron rod, having rivetted at right angles to its extremity a flat disc of iron, the disc being a little smaller than the inner circumference of the crucible. To the negative wire of the battery I attach a simple rod or bar of iron. The matter in the crucible being in a state of fusion and well fluxed, I place the above-mentioned disc of iron, which will now form the positive pole of the battery, on the surface of the fused mass, and keep the rod which is connected with the negative pole in contact with the outside of the crucible, the bottom of which thus forms the negative pole. The fused matter now forms a portion of the electric circuit; and the heat being kept up, the metal is gradually reduced and deposited at the bottom of the crucible."

The battery employed by Napier consisted of five pairs of plates for every hundredweight of regulus of thirty per cent. of metal. The internal resistance of the battery was quite low, as will be seen from the dimensions of the plates: "The size of zinc plates being three feet square, and the copper being doubled round the zinc in the usual way."

Napier did not limit himself to the use of the particular character or size of battery described. He says in the specifications of the patents before referred to: "The power of the voltaic battery, or other means of generating electricity which may be used, will vary for different ores, and I have found that if a larger battery be employed with the same quantity of ore, the time required for the extraction of the metal will be shorter, and *vice versa*; and if a more powerful voltaic combination be used a smaller sized battery or a shorter time will suffice."

The following additional details are given concerning the process: "Whether a crucible or other vessel or furnace be employed to contain the fused ore, it should have its bottom, or a sufficient portion of it at the lowest part, formed in the interior of plumbago or other suitable electro-conducting material with which the negative rod can come in contact. The positive pole should consist of an electro-conducting material, and I have found iron, as above described, the most convenient and satisfactory, although I have also found that coke may be used. The thickness of the wires or straps of metal used for connection should increase with the size of the apparatus. For the proportions above given I have found straps of ordinary sheet copper of an inch broad sufficient."

Structurally, the Napier electric furnace consists of the following elements in combination:

(1) A crucible or other receptacle of refractory material that is at the same time a conductor of electricity.

(2) A lining or luting applied to the inside of such crucible so as to necessitate the passage of the decomposing current through the melted mass to be treated.

(3) The combination with such a crucible of an external source of heat.

(4) The combination with the fused ore, contained in the crucible before mentioned, of the electrodes of a fairly powerful voltaic battery, or other electric source, so connected with the crucible as to permit the current to pass through the fused mass.

NEW ALTERNATING DYNAMOS.

By R. KENNEDY.

THE remarkably rapid progress made by the system of distribution of electricity by alternating currents and transformers both in America and Europe has turned the attention of the leading electrical engineers to the improvement of the alternating dynamo machine and transformers.

Transformers are such simple affairs that no interesting improvement can be made in their design, but the dynamo lends itself readily to a great variety of different designs, and can be arranged in its parts in many ways, although all of them contain the same simple essential features. The new arrangements recently brought forth may be classed into two divisions —first, those with iron cores in the armature; and secondly, those without iron cores; these divisions divide again into two classes, machines in which the armature poles are alternately reversed in polarity, and machines in which the armature is magnetised and demagnetised alternately without reversal.

In considering the applications of alternating dynamos it is very essential to classify them in the above manner, because they do not all behave alike in some important particulars. The most recent dynamo publicly described is the Mordey dynamo, which has a field magnet of new design built on the "ironclad" principle, a principle of design which was first suggested by Mr. Kapp as applicable to dynamos, and which has been applied to continuous current dynamos by many makers.

The field magnet is a cast iron shell with a nearly closed magnetic circuit, the only break in the circuit being a narrow cut in which the armature coils pass through the magnetic field; these fields are not alternately reversed, they are all similar, and therefore to obtain the induction of alternating currents in the armature coils, one half of the coils are gaining magnetism while the other half are losing magnetism; this is brought about by making the armature coils double in number to the magnetic fields. All the poles on one side of the armatures are of N, and all the poles on the other side are of S polarity, and these poles are obtained by one exciting coil enclosed by the field magnet ends. This coil is of simple cylindrical form, and therefore is of the best shape and in the best position to withstand rapid revolution; in fact, this field magnet is mechanically and magnetically very superior; it would seem, however, to be a rather difficult job to make such a field magnet of wrought iron, but that remark might be made about all forms of magnets for large alternating dynamos.

The field magnet is really the novelty in this machine. Ironclad alternating dynamos are, however not a novelty. The author has an ironclad dynamo which has run continuously since November, 1886, distributing alternating currents over a two mile circuit, supplying two shops with 80 lights through a transformer. This machine may be seen at work any day by calling at the Belt Works in Cumberland Street, Glasgow; the shops lighted from it are at the Glasgow Cross.

In this machine the magnets are fixed and the armature rotated. All the poles are of N polarity on one side of the armature and all the poles on the other side are of S polarity, and all the poles are obtained by the use of two plain circular coils laid into a cast iron shell forming a nearly closed magnetic circuit; one coil is sufficient, but it is divided into two for convenience of handling.

In Mordey's machine the poles of the field magnets on opposite sides of the armature are directly opposite each other, and must be so, as he has no iron in his armature.

In the author's machine the poles are not directly opposite each other, but the poles on one side are opposite the spaces between the poles on the other side, and this must be so because iron is used as a core in the armature coils. This explains all the difference between

the two dynamos; in the one no iron is in the armature, and in the other iron is used very largely, and hence the different disposition of the magnetic fields.

Iron is used in the armature of an alternating dynamo for a very particular purpose.

Dynamos at a central supply station must be run in parallel connection with each other, and the best arrangement seems to be to have a number of moderately sized dynamos driven direct from independent engines by good belting. By adjusting the speeds closely, alternating dynamos thus driven are found to work well in parallel connection; they fall into steps suddenly, maintain the same phase, and continue to work together; this they do all the more readily if plenty of iron is used in the armature cores. In fact, armatures without iron in the cores of the armature are difficult to bring into the same phase, and very easily thrown out of phase again; at least that is the author's experience, and the experience of a few others who have made the experiment.

Perhaps in the Mordey machine this difficulty does not exist, considering that the poles are not alternately reversed; at any rate the adoption of iron in the armature surmounts the difficulty. Flat ring or disc armatures containing iron cores have another difficulty when made of large diameter and placed between two sets of powerful poles, and that is the tendency to bend over and strike the poles of the field magnets, more especially if the armature is the rotating part of the machine.

From these considerations drum armatures are adopted by many makers, notably Zipernowski, Westinghouse, and in the old Gramme machine. In some of these the field magnets are inside, and from the revolving part in others the drum is inside, and forms the revolving part.

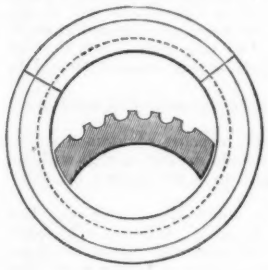


FIG. 2.

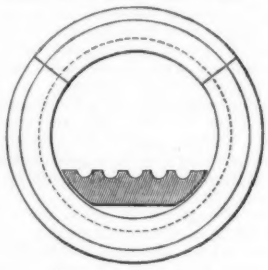


FIG. 1.

In another article describing some other new machines, the ironclad dynamos as made for alternating currents will be illustrated and more particularly described, together with a description of a very promising machine as made by Messrs. Muirhead and Hopkinson some years ago.

(*To be continued.*)

LAYING UNDERGROUND CONDUCTORS.

By CHAS. W. FARQUHAR.

THE difficult subject of laying underground conductors must now be seriously faced both from commercial and scientific points of view, and I quite agree with the remarks of Mr. R. E. B. Crompton in his admirable paper on Electric Lighting from Central Stations, viz., "Nor is any great extension of the present system of overhead wires, such as you see radiating from the Grosvenor Gallery, likely to be allowed. We, therefore, have to devote all our energies to the best, cheapest, and most durable methods of laying our conductors underground."

Having myself had a large and most varied practical experience of electric light installations, it is with pleasure and with your kind permission that I now bring before your readers a new and, I believe, practical and economical system of laying electric conductors underground. Before entering into a description of this system, it might be interesting to note that possibly no trade has benefited more by the advancement of electrical science than that of stoneware and earthenware manufacture.

The extension of our telegraph and telephone systems has created such a trade in insulators that but few have any idea of its magnitude.

This, however, is equalled, if not surpassed, by the manufacture of battery jars and porous cells and a later advancement has brought about the manufacture of accumulator jars, though these for various reasons are preferably made of glass. Again, we find, that owing to the proper action of fire insurance companies, wood has given place to stoneware in the construction of switch and cut-out blocks, &c.

The following is a brief description of the system now being introduced (under a patent) by the firm of Doulton & Co., Lambeth, London:—The receptacle for the conductors as shown in figs. 1 and 2 is an ordinary circular stoneware pipe with a socket at one end, which is pressed out in one operation, but before being fired a cut is made down the entire length, but not quite through the thickness. This allows the pipe to retain its structural strength during firing and thus avoids any warping. After being fired the top portion (about $\frac{1}{3}$rd) can be easily removed by a little gentle tapping, and the lower portions of the pipes are laid in the trenches.

At requisite intervals loose stoneware carriers are dropped in; these carriers are grooved with notches

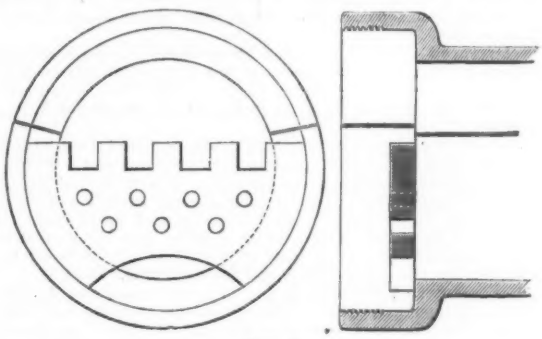


FIG. 3.

which carry the number of wires required, at the same time keeping them separated and suspended from the bottom of the pipe.

When the bottom row is completed, fresh carriers are dropped in above, as shown, and when the wires are laid on these the top portions of the pipes can be placed on, which by the V formation of the cut securely fix themselves. A slight layer of cement along the joint will render them water tight. As condensation will take place in any system of underground pipes, Messrs. Doulton are making a certain number of pipes in each section with a 2 inch junction at the bottom, so that a small pipe can be led off and thus drain the section either into a constructed catch pit or else through a trap into the sewers.

Fig. 3 represents a similar system, but instead of the carriers being loose there is an eathenware disc notched at the top for heavy wires or bands and pierced through for threading smaller wires. This bridge or disc, as is shown, is fixed in the sockets of intervening pipes at such distances apart as may be necessary. If only for the sake of inviting your readers to co-operate in the solution of this difficult question, I shall feel satisfied by the insertion of these remarks.

Central Station in Amsterdam.—The Helios Company of Cologne are erecting in Amsterdam a central station for an output of 2,000 ampères at 65 volts. The cables are designed for a loss of two per cent. only. Current will be supplied by two steam dynamos, each driven by a twin engine, the fly wheel of which carries the armature.

FIRE RULES.*

RULES OF THE NEW ENGLAND INSURANCE EXCHANGE FOR ELECTRIC LIGHTING BY THE INCANDESCENT SYSTEM.

OUTSIDE WIRES.

1. All outside overhead wires must be covered with some material of high insulating power, not easily abraded, and impervious to moisture, and they must be firmly secured to properly insulated and substantially built supports. All tie wires must be insulated the same as conducting wires.

2. All joints must be so made that a perfectly secure and unvarying connection, fully equal to the cross-section of the conducting wire, will be secured—and they should be soldered. All joints must be securely wrapped with at least five layers or ply of an approved tape.

3. Care must be taken that conducting wires are not placed in such position that it would be easy for water, or any liquid, to form cross-connection between them, and they should not approach each other nearer than one foot.

4. The wires must never be allowed in contact with any substance other than air, and their proper insulating supports.

5. Conducting wires carried over or attached to buildings *must* be at least seven feet above the highest point of flat roofs, and one foot above the ridge of pitch roofs.

6. When they are in proximity to other conducting wires, or any substance likely to divert any portion of the current, *dead, insulated* guard irons must be placed so as to prevent any possibility of contact in case of accident to the wires or their supports. The same precautions must be taken where sharp angles occur in the line wires, and also where any wires (telegraph, telephone or others) could possibly, owing to their position, come in contact with the electric light wires.

7. Lines constructed subsequent to the adoption of these regulations should not be run over and attached to buildings other than those in which the light or power is being, or is to be used, but should be on separate poles, where they can be easily reached for inspection.

8. Overhead service wires from street mains to main cut-out inside of building must be separated by a distance of not less than 6 inches, for currents having an electromotive force of 130 volts or less, and this distance must be increased for currents of higher potential.

9. They must also be rigidly and neatly run, and must be supported by glass or porcelain insulators or by rubber hooks. Rubber hooks must be of an improved pattern; *i.e.*, with the rubber insulation free from flaws, and projecting over the hook in cup form.

10. Service blocks must be protected by at least two coats of water-proof paint over their entire surface; and when used to support rubber hooks, must have at least one inch of wood between the inner end of the hook and the back of the block.

11. For entering buildings, wires of extra heavy and durable water-proof insulation, protected by an outside covering not easily abraded, must be used from the terminal insulators outside to the main cut-out inside of the building. They must loop down so that water may drip off without entering the building, and the holes through which they enter must slant upward.

12. Service wires must come in contact with nothing save air, and their insulating supports, except in unavoidable cases, when a wire with an extra heavy insulation suitable for the purpose must be used.

13. The use of porcelain knobs as insulators, except in perfectly dry places, or for the support of a specially insulated wire, will not be allowed.

UNDERGROUND SERVICES.

14. Where underground service conductors, inclosed in a metal tube, enter a building special care must be taken at the point where the conductors leave the tube, and thence to the main cut-out, to protect them in such a manner that they cannot come in contact with each other, nor with the tube, nor be acted upon by falling moisture, nor disturbed by anything being moved against them, &c.

15. This service must not end at any place where it would be unsafe or undesirable to place a cut-out, but should be continued by means of specially insulated conductors to a suitable location.

INSIDE WIRING.

16. Copper wire used for incandescent lighting must be procured from manufacturers whose products have been found, by reliable tests, to be at least 95 per cent. pure copper. Samples of wire to be used, or in actual use, must be submitted to this exchange, for tests of conductivity, at any time when required.

17. Permission will not be granted for the use of lights unless the wire comes fully up to the standard of conductivity, no matter how well the wiring may be done.

18. All parties, firms, or corporations proposing to do construction work or wiring, either outside or inside, must first satisfy this Exchange of their ability to do so in a safe and acceptable manner.

19. Before using any new forms of insulation for concealed work, the approval of this exchange for its use under the proposed circumstrnces must be secured.

20. "Underwriters' wire" must be used only in perfectly dry places, and places free from the vapours of ammonia, &c. It must be used only for cleated work, and must not be concealed.

21. Wires in moulding, or concealed from sight within partitions, over ceilings, or in any other way, must have a special insulation, capable of resisting abrasion, durable and waterproof.

22. When wires are run in new buildings, and are to be concealed from view by walls and ceilings, care must be taken to separate them 10 inches or more, whenever it is possible to do so, by running them singly on separate timbers, studding, &c. Care must also be taken to keep the wires away from the gas pipes and other conductors. Outlet wires should be left in such a way as not to be injured by plasterers, and when brought through in connection with gas pipes must be carefully insulated from them.

23. Moulding must not be used in wet places.

24. In dye houses, paper and pulp mills, or other buildings specially liable to moisture, all wires (except when used for pendants) must be separated at least 6 inches. The wire must have a durable waterproof covering, must be thoroughly and carefully put up, and must be supported by glass or porcelain insulators, or by rubber hooks.

25. Wherever wires cross gas or water pipes, or other bare metal, or any other wire (except an arc light wire), they should be separated from the same by some continuous non-conductor at least one-half inch thick. In wet places an air space must be left between wires and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally.

26. Where wires pass through partitions, floors, &c., an outer sheathing of wood or hard rubber should be used to protect them.

27. Wires must never be left exposed to mechanical injury, or to disturbance of any kind.

28. Metallic staples must never be used to fasten wire.

29. Soft rubber tube will not be accepted as a durable waterproof insulation.

30. Wires of the same polarity, but belonging to different circuits, or leading to and from a double-pole switch, must not run in one groove, through the same tube, nor in the same slot in a cleat, unless specially insulated.

31. Cleats should be made of well-seasoned hard wood, porcelain or other approved material. When secured by cleats not over 4 feet apart and tightly stretched in the same horizontal plane, wires having a difference of potential of 120 volts or less, should be separated at least 1½ inches; when they are confined in molding, a half-inch space is sufficient. This rule applies only to small mains, taps, &c.; large mains carrying strong currents should be separated a greater distance.

32. The dividing strip between grooves in moulding must never be cut out to admit joints in wires.

33. Where exposed to acid fumes, vapours of ammonia, &c., wires must of course be provided with an insulation that will not be injured thereby, and should be put up in the manner described in Rule 25.

34. All splices in wires must be soldered; a soldering bolt should be used for this purpose, if possible. Care must be taken not to render the wire brittle by overheating. Resin must not be used as a flux. Nothing stronger than a 10 per cent. acid solution should be used, and any excess should be washed off before the splice is covered.

35. The insulation of any joint must be equal to that of other parts of the same wire.

SAFETY CUT-OUTS AND SWITCHES.

36. Every part of the system of conductors must be protected by safety cut-outs that will interrupt the passage through any conductor of a current stronger than that conductor can safely carry. The carrying capacity (in ampères) of a fusible metal must be less than that of the smallest conductor it is designed to protect. Conductors, of course, include wire, cord, binding screws, contact points of switches, sockets, cut-outs, &c.

37. A cut-out must be placed where the underground or overhead service joins the inside wires, and at every point where a change is made in the size of the wire (unless the cut-out in the larger wire be designed to protect the smaller).

38. Cut-outs, switches, and other devices which occasion a break in the insulation, must be so mounted that leakage of electricity from them is impossible, must not be put in places liable to become damp, must be protected from rubbish, &c., and should be easy of access.

39. Where it is necessary to use cut-outs and switches in damp places, great care must be taken to protect them from moisture, and to use only such as are provided with bases that will not absorb moisture.

40. When necessary, cut-out connections must be covered with some fire-proof and water-repelling material.

41. Cut-outs connected for carrying five ampères or more must be double-pole.

42. The plug or other device for inclosing or supporting the fusible strip or wire must be incombustible and moisture proof, and so constructed that an arc cannot be maintained across its terminals through the vaporising of the fusible metal.

43. No lead or composition strips carrying fifty ampères or upward before melting, must be used, unless provided with contact surfaces of some harder material having perfect electrical connection with the fusible part of the strip.

44. All switches must have a firm and secure contact that will make and break readily, and that will not stick between "full on" and "off," nor get out of repair easily in other ways. The points of contact must not be allowed to scrape or rub the entire surface of an insulating material between the contact strips; an air space

* The rules applying to arc lamps were published in the REVIEW for April 13th, 1888.

must intervene. The carrying capacity of the different parts must be sufficient to prevent heating.

45. Where points varying widely in potential are brought near each other by means of cut-outs or switches, hard rubber, lava, or other approved material must be used in the construction of the cut-outs and switches.

46. Switches carrying five ampères and upward should be double-pole, particularly when the circuits which they operate are connected to fixtures attached to gas pipes.

47. On any one fixture, no group of lamps requiring a current of seven ampères or over must be ultimately dependent on one cut-out.

FIXTURE WORK.

48. In all cases where wires are concealed within or attached to fixtures, the latter must be insulated from the gas pipe, by some device approved by this Exchange. An exception to this rule will sometimes be made in the case of a gas bracket wired for one or two lights.

49. When holes are drilled in fixtures all burs or fins must be removed from the edge of the holes before the wires are drawn through.

50. When wired outside, the cord or wire used must be so secured as not to be cut or abraded by the pressure of its fastenings or motion of the fixture.

51. All wire used for fixture work must have an insulation that is moisture proof, durable, and not easily abraded.

52. Each fixture must be tested for possible "contact" between wire and fixture, and for "short circuit," before current is turned on.

53. The tendency to condensation within the pipes of fixtures should be guarded against by sealing the upper end.

PENDANTS AND SOCKETS.

54. No portion of the lamp-socket exposed to contact with outside objects must be allowed to come into electrical connection with either of the conducting wires.

55. Cord pendants must be protected by hard rubber bushing, or something equally good, where they enter the socket.

56. The use of paraffined insulation for pendants will not be allowed.

57. Every pendant must be supplied with a ceiling cut-out, except in cases where it is necessary to use waterproof wire pendants (as in wet rooms), and to connect the same to the wires overhead by means of a splice.

58. Key sockets must not be used with wire pendants, unless the wire be composed of strands—*i.e.*, flexible.

59. When exposed to weather, or used in wet rooms, care must be taken to keep moisture from the inside of sockets.

60. The weight of socket and lamp suspended by a cord should be borne by a knot within the ceiling cut-out, and by one under the bushing in the socket.

61. "Underwriters' wire" must not be used for pendants; when it is necessary to use ordinary inflexible wire, it must have a special insulation.

62. Cord used for pendants should have four coverings, one of them composed of rubber or other moisture-proof material.

DYNAMOS AND MOTORS.

63. They must be located in dry places, not exposed to flyings of combustible material, and must be insulated upon dry, well varnished wooden foundations. They must be kept thoroughly clean and dry. In wiring for motive-power the same precautions should be taken as with a current of the same strength and potential for lighting. The motor (and resistance box) should be protected by a cut-out, and controlled by a switch.

SECONDARY GENERATORS OR CONVERTERS.

64. Converters must not be placed inside of any building. They may be placed on the outer walls when in plain sight and easy of access, but must be thoroughly insulated from them. If placed on wooden walls, or the woodwork of stone or brick buildings, the insulation must be fireproof. When an underground service is used, the converter may be put in any convenient place that is dry, and does not open into the interior of the building—this location must have the approval of the inspector before the current is turned on.

65. The converter should be inclosed in a metallic or non-combustible case.

66. If, for any reason, it becomes necessary that the primary wires leading to and from the converter should enter a building, they must be kept apart a distance of not less than 12 inches, and the same distance from all other conducting bodies. The insulation of the wire must be of the very best.

67. Safety fuses should be placed in both the primary and secondary wires in the converter. Secondary wires after leaving the converter will be subject to rules already given for service, inside wiring, &c.

MISCELLANEOUS.

68. Companies or individuals furnishing electricity from central stations must enter into an agreement with this Exchange, binding themselves to maintain at all times in their station some approved device to indicate instantly any escape to earth which may tend to develop leakages to water or gas pipes, or other earth connections within buildings. This approved means of testing shall also apply to separate or isolated plants, where special conditions of moisture exist, or in buildings subject to mechanical changes of piping, &c.

69. The signing of these rules and requirements shall constitute and be considered an agreement on the part of the signer, that such approved automatic device or telltale shall at all times be employed on their circuits.

70. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magneto that will ring through a resistance of 10,000 ohms, where currents of less than 200 volts potentials are used.

71. All incandescent work should be inspected before the current is turned on.

72. The New England Insurance Exchange reserves the right at any time to add to, change, or modify these rules, and to enforce such modifications, changes, &c., as it shall deem necessary for safety; and it will use all reasonable efforts to promptly notify all electric light companies of any change.

73. The inspector's certificate must specify the kind, number and size of lamps which may be installed, or their equivalent in ampères. Any additional loading of wires, either in a building as a whole, or in any department thereof, without the previous approval of this Exchange or the inspector, shall be deemed a sufficient cause for the suspension of permits until such approval is secured.

INCANDESCENT LAMP PATENTS.

EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY *v.* HOLLAND AND OTHERS.

(*Before* MR. JUSTICE KAY.)

(*Continued from page* 570.)

WEDNESDAY, MAY 31ST.

Mr. SWAN'S re-examination by the ATTORNEY-GENERAL was resumed this morning.

The ATTORNEY-GENERAL: I was referring to some letters which passed between you and Mr. Stearn. Did you intend to take out patents in the year 1879?—My taking out patents was really contingent upon what we discovered. If I did not discover anything that seemed to be worthy of patenting, I should not take them out.

Can you tell me whether it was known to Mr. Stearn that you intended to take out patents?—No, I cannot say that. We had not discussed that point very much.

You remember a letter from Mr. Stearn, dated October 3rd, 1879, in which he suggests the blocks and strip of carbon being made in one piece. What was that to obviate?—It was to keep the connection between the carbon and the supporting conductor cool.

Do you remember whether any pieces of carbon were made like that in 1879?—I do not remember making any myself, except those I mentioned made out of graphite.

You stated that you had pared down the middle of a piece of graphite, but you did not remember doing so with Carré carbon?—Yes; I rubbed a lead pencil down with very fine emery paper.

Was that subsequent to Mr. Stearn's suggestion?—I cannot answer that question. I think it is very likely the same idea occurred to myself and that I had done it independently.

You have said that you are quite sure that Mr. Heaviside and Mr. Proctor were mistaken in the date when they said they saw in your engine room in the year 1879 several lamps of the shape of a radiometer. Is that (showing lamp) the shape of a radiometer?—The external form of the bulb is the same, but the stem is thinner and shorter, and the bulb is generally considerably larger.

Prior to your fire (January, 1880), except to F. J. B. 1, and the lamps like it, had you produced any thread or paper lamps?—I produced those that have been described of paper. No thread lamps had been produced. I had produced three or four paper lamps which had gone to Mr. Stearn and come back, and did not turn out successfully.

Have you any doubt about that at all?—I have not the slightest doubt.

Prior to January 1st, 1880, the date of the letter in which you speak of your experiments of the previous six months, and of having overcome the difficulty, had you exhibited any lamps, apart from sending them to Mr. Stearn, except F. J. B. 1?—I did not exhibit any other lamp publicly. I am exempting the private exhibitions to Mr. Heaviside and Mr. Proctor, not of thread lamps, but of lamps more like F. J. B. 1 in respect to the incandescing materials. I daresay they did see some unsuccessful paper carbon lamps.

You told Sir Horace Davey that you thought towards the end of the year you did mount a hairpin Carré carbon. Just look at the letter of November 26th, 1879, from Mr. Stearn to you:—"Yesterday evening and the evening before I again attacked the problem of the lamps. . . . Last night I tried one of the hairpin form carbons." Do you know whether he had had any hairpin form carbons before?—I do not know absolutely, but I should think this would be about the first.

When did you first begin experimenting with heating a lamp before it was sealed?—I cannot answer that question. I think that it had been used for a considerable length of time before the date of this letter.

Did you know at that time that the same process had been described by Mr. Edison?—No, I did not; nor do I now.

Were you aware of the description in Cheesbrough about keeping the pumps running whilst the gases were being driven out?—No, I was not.

You remember being asked as to what was new in Edison's specification. "I have discovered that even a cotton thread, properly carbonised and placed in a sealed bulb, exhausted to one-millionth of an atmosphere, offers from 100 to 500 ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures." Apart from your lamp, F. J. B. 1, do you know of any enunciation of that before?—No.

"If the thread be coiled as a spiral and carbonised"—do you know any enunciation of that prior to this?—No; that as a publication was new.

And wood splints—was carbonising wood splints known before that time?—I think King's specification may be construed to include wood.

Except F. J. B. 1, do you know of any publication of the combination described in that specification before the date of that specification?—No, I do not.

Mr. CHARLES HENRY STEARN examined by the ATTORNEY-GENERAL: I have been subpœnaed here by the defendants. I am managing director of the Swan United Company's foreign business. In the year 1877 I was a clerk in the Bank of England at Liverpool, and was residing at Rock Ferry, near Birkenhead. I commenced to use the Sprengel pump in 1872. From 1877 to 1880 I was engaged with Mr. Swan in experimenting. I received during that time a number of letters from Mr. Swan, but did not keep them. I also wrote several letters to Mr. Swan, and have since seen copies of them, which enable me to fix the dates of occurrences of that time. In the letter dated August 24th, 1877, there is mention of some carbons which he was to send me. Those were paper carbons. He continued to send me carbons to be made into lamps down to 1880. No one else sent me any. The bulbs were blown by a Mr. Topham and his son, glassblowers. Of the lamps like F. J. B. 1, I should say there were no more than half-a-dozen made, and probably not more than three or four. I cannot speak with exactness, but I believe not more than 20 lamps were made in the year 1879. Prior to January 12th, 1880, I did not make any lamps containing carbonised thread. It was always understood that Mr. Swan's object was, when we had investigated the ground, to take out patents. It is not true that I had in my house in 1879 carbonised flax thread lamps. Witness gave further evidence as to the dates at which he received certain carbons from Mr. Swan, his testimony upon these points corresponding generally with that of Mr. Swan.

Cross-examined by Mr. FINLAY: He wrote a paper in English for a German technical publication upon incandescent lamp history, but the paper was not published as he wrote; some parts were left out, and fresh matter was inserted. In the paper which he wrote he endeavoured to show that the essential principles of incandescence lighting were well known prior to November, 1879. The Swan Company abroad, of which he was the manager, was in litigation in Germany with the Edison Company upon the German Edison patent, which was similar to the English patent, except that the second claim for the combination had been struck out in the German Patent Office. He had never seen and never heard of any lamps made under Edison's first patent being used commercially. He was not prepared to swear that he had no thin arched carbon lamps at his house in the summer of 1879, but his belief was that he had none. He depended entirely for dates upon his letters, and they were in some cases vague.

Re-examined: He was not connected with the plaintiff company except as a shareholder. His object in writing the paper for the German periodical was not so much to advocate Mr. Swan's claims as to oppose those of Edison.

CHARLES FREDERICK TOPHAM, who had assisted in blowing the lamp bulbs for Mr. Stearn, spoke of various forms of conductors which were handed to him to be placed in bulbs, but could give no precise dates, referring, for the purpose of indicating the order in which he received the carbons, to the situation at the time of Mr. Stearn's laboratory, which was at one time upstairs, later down, and at a subsequent period in the next house. He was about fifteen at the time he did this work, and had been in Mr. Stearn's service ever since the new laboratory was opened in the house next door to Mr. Stearn at Rock Ferry.

Mr. JOHN IMRAY, recalled, said he was a manufacturing engineer from 1850 to 1867, and he knew that carbonising in charcoal was common knowledge at that time, and long before. To produce carbons to be used in connection with patent axletrees, wood shavings were placed in a box which was packed with charcoal and luted with fireclay, and subjected to heat in a furnace. When the process was completed he found that the shavings were not destroyed, the fibre of the wood being clearly apparent. He had carried out the process of carbonising in sand within the past month. In one case the sand employed was dry, in another, after hearing the evidence of the defendants upon the point, he added sufficient water to thoroughly soak the sand. He tested some of the filaments produced in the dry sand, and found them fairly good conductors. In the wet sand the filaments were perfectly carbonised, but the sand was so coherent that he could not extract them very well; he succeeded, however, in mounting one with lampblack and tar putty to platinum wires, got a glass-blower to blow an ordinary test tube into a bulb and exhaust it, and then ran the resulting lamp on a current of 30 volts, at which pressure it gave an excellent light. On May 28th he visited the works of the plaintiff company, and saw a boy making filaments of lampblack and tar, rolling them between two plates of glass, seeming to have no difficulty in doing so. The witness continued to describe processes of carbonisation which he saw performed, and also processes which he had himself performed, one being the carbonisation of a filament without packing of any sort in a brass crucible similar to that produced by Prof. Dewar. From what he had done himself, and from what he had seen and heard, he was satisfied that everything described in Edison's specification was the result of actual trial and achievement.

The examination of the witness had not concluded when the Court rose.

THURSDAY, MAY 31ST.

Mr. IMRAY was this morning subjected to cross-examination by Mr. FINLAY upon his experiments in carbonising in sand. He stated that the carbon filaments would themselves give off vapour which would drive out sufficient oxygen to prevent combustion taking place.

Mr. CHARLES HENRY GIMINGHAM, resident superintendent of the plaintiff company's factory, said that in the early days of making filaments, seven years ago, the heat from a gas furnace, and subsequently from a coke furnace, was employed in carbonisation. At that time the process lasted only for about two and a half hours, but the length of time had been gradually increased until at present it was customary to subject the filaments to heat for fourteen hours; the heat of the furnace was gradually increased for twelve hours up to a dull red heat, when it was augmented to a white heat and kept at that temperature for two hours. Lampblack and charcoal packing was first used, but since plumbago had been largely employed. He had never found any difficulty in carbonising filaments in these modes. He had made a number of lamps from filaments carbonised in the cast iron box used by Mr. Imray for his experiments. He had had filaments made in the spiral form mentioned by Edison, and mounted in lamps. These filaments were made with a mixture of 20 per cent. of oxide of zinc with lampblack and tar. The light from the lamps so made he preferred to that from the single loop lamps, because there was a more uniform ball of light, and the form of the filament was not so distinguishable. One of those lamps was run for 41 hours. The examination of the witness was proceeding upon the sufficiency of Edison's specification, when

Mr. JUSTICE KAY said it would be much more satisfactory to him if the whole of the experiments mentioned in Edison's specification were carried out, from the very beginning, in the presence of the expert witnesses of both sides. It seemed to him that it would save a great deal of very troublesome cross-examination.

The ATTORNEY-GENERAL agreed that this would be an advisable course, and suggested that an independent witness, to be selected by his lordship, should also be present when the experiments were made.

Mr. FINLAY also agreed, and a discussion as to details took place.

Mr. JUSTICE KAY said he was confronted with a direct conflict of evidence, and he should like to have the experiments conducted in this way: There should be at least six lamps made, and the whole manufacture from the beginning—the making of the filament, enclosing it in a lamp, exhausting, and so on, should be carried out according to Edison's description in his specification, and he wanted witnesses on both sides to be there to see that it was fairly done, and if they saw anything that was not fair they could report, and the "moderator," or independent witness, should also give his report.

Mr. FINLAY suggested that there should be some direction from his lordship as to what was to be done, whether there should be packing in charcoal and sand or not.

Mr. JUSTICE KAY said he should wish it to be done both ways.

The ATTORNEY-GENERAL: Or in three ways, my lord, without packing at all.

The names of Sir William Thomson and Sir Henry Roscoe were mentioned as the independent witness, but no decision was at the moment come to upon that point. It was decided that the experiments should take place on Friday and Saturday, and the reports be presented on Monday next, until which day the Court, on rising, would postpone further consideration of the case.

The examination of the witness was continued.

A lamp was produced, which he said had had the bulb blown over the filament, the bulb being originally a glass tube. It was the practice to blow bulbs over the carbon in the small lamps used for microscopic and surgical purposes; lamps were so manufactured in hundreds, and there was no more difficulty in that mode of blowing than in the other.

Cross-examined by Mr. GRAHAM: The carbonising of filaments was never done without packing nor without a frame. Had never sold a single lamp the filament of which was made in a brass box similar to that produced by Prof. Dewar, or in a brass tube.

Mr. R. T. GLAZEBROOK, F.R.S, demonstrator of physics at the Cavendish Laboratory at Cambridge, examined by Mr. MOULTON, said he had carried out Despretz's process with carbons of the various sizes which Despretz mentioned. He found that a current of 6 ampères was not sufficient to produce the physical results which Despretz described; he believed they were not produced under 38 ampères, and was sure that the results were produced when the current rose from 44 to nearly 100 ampères.

This concluded the evidence. It was announced that Prof. Crookes and Prof. Silvanus P. Thompson would represent the defendants at the experiments to be made. Who would act on behalf of the plaintiffs was not stated, nor was any definite arrangement made with respect to the independent witness, it being left to the counsel to agree upon someone and report to his lordship next morning.

NOTES.

Central Station Lighting in Hamburg.—The Town Council of Hamburg is erecting an electric light central station, the capacity of which is to be for 10,000 lamps at present, but with provision to increase it to 20,000 lamps next year. A district of 13,000 feet radius is to be supplied. In December next a portion of this installation is to be in working order. Motive power will be supplied by four steam engines of together 1,100 H.P., viz.: One of 100 H.P., one of 200 H.P., and two of 400 H.P. There will be six dynamos, one of 1,000 and five of 2,000 lights capacity. For street lighting there will be fixed 64 arc lamps.

Queenstown and the Electric Light.—The committee appointed at the last monthly meeting of the Queenstown Town Commissioners to report upon the proposal to light the town by electricity met last week. Mr. J. A. L. Carbery, J.P., who presided, explained at some length the principal features of the proposal. He believed that the sooner they got electric lighting in the town the better it would be, and was sure that when they had heard the facts he had to lay before them they would be of the same opinion. When last in London he made it his business to inquire about electric lighting, which certainly had been brought to great perfection within the past year. By getting electric lighting in Queenstown the commissioners would not only be able to save £460 a year they were now paying for the gas, but they could also supply the shopkeepers of the town with a clean, bright, wholesome light for their shops, 60 times brighter than the light they at present used, and they could supply it at nearly half what the gas costs them at present, so that the commissioners would derive an income from that supply that would give them the public lighting for nothing. He submitted an estimate from a new electric lighting company in London undertaking to give 40 arc lamps with engines, arc-dynamo and working gear, complete with six miles of arc cable and 40 iron posts, at a considerably less sum than the gas now costs. At present they had 124 gas lamps to light the town, and they paid £430 a year for the gas alone supplied through those lamps, to say nothing of the cost of keeping and maintaining them. The commissioners would have the electric light plant in their own hands and under their own management. The supply to private consumers would be a very simple matter, as this could be done from the then existing main conductors by means of the incandescent system; so that instead of paying, as at present, £430 a year for the illumination of the town, the commissioners would speedily have acquired rights over a realisable asset capable of very great extension. Mr. Harris said that some years ago the commissioners had entered into negotiation to buy the whole gas concern for six times the amount it would now cost to light the town by electricity. Shopkeepers would, he said, save at least 30 per cent. in the lighting of their shops by electricity. He proposed the following resolution, "That we invite tenders for the public lighting of the town by electricity, as well as for supplying private consumers, those tenders to be submitted to the meeting of the commissioners on the 2nd July." Mr. M'Donnell seconded the proposition, which was agreed to, and the proceedings then terminated.

Electricity versus Gas.—During the first three months of the year 1887 there were formed in the Southern States of North America 15 companies for the supply of gas lighting, and 17 for electric lighting.

The Lighting of the Brighton Pavilion.—At the last meeting of the Brighton Town Council Alderman Abbey made a short statement with regard to the electric lighting arrangements at the Pavilion. When the Maxim-Weston Company threw up their contract it was necessary for the Pavilion committee to continue the work. The latter became rather protracted, and at length the committee became somewhat impatient. They met Mr. Preece, and on visiting the rooms on the previous evening found them all lit up with electricity. The light was now perfectly satisfactory, and might be used at any time, the representative of the insurance companies having declared it quite safe. When the Maxim-Weston Company relinquished the contract the Corporation owed them £125, but the company were now indebted to them in the amount of £250 for the work which they had not carried out. The matter then dropped.

Electric Railways for Japan.—Japan goes ahead. The Mikado has now commissioned an engineer to visit the States, to gain information with the intention of introducing electric railways into Japan.

Electric Lighting at the Vienna Jubilee Exhibition.—This installation will be divided into three groups:—The first, for the lighting of the Rotunda and adjacent galleries will be supplied with boilers having a heating surface of 8,500 sq. ft., and seven engines, three compound of 200, 200, and 120 H.P., two single cylinder of 100 and 170 H.P., and two high speed of 60 and 50 H.P., and one vertical ship lighting type of 60 H.P. The second and third groups will have boilers with a heating surface of 6,000 sq. ft., for the external and machinery hall lighting, and four engines, one high speed of 50 H.P., one Colman of 80 H.P., and two ship lighting of about 180 H.P. each. The dynamos to be supplied are as follows:—Five Gülcher for combined arc and incandescence lighting, four Krizik for arc lights and one for incandescence lamps, six Ganz for arc lighting and two for incandescence lamps, two Egger & Co. for arc lighting and one for incandescence lamps, two Kremenezky, Meyer & Co. for arc lights and two for incandescence lighting, two Siemens & Halske for arc lighting and two for incandescence lamps, and six Edison-Hopkinson.

Electric Light at the Brussels Exhibition.—Contracts have been entered into, for the lighting of the Exhibition, with the following firms:—The Thomson-Houston Company for 76 arc lights of 10 ampères; the Société Industrielle, 50 arc lights of 7 ampères; Messrs. Bouckaert & Cie, 60 arc lights of from 8 to 16 ampères; the Compagnie Electrique, 22 arc lights of 12 ampères, and 75 glow lamps; M. Khotinsky, 250 glow lamps; Herr Zipernowski, 200 glow lamps; Anglo-American Brush Corporation, 40 arc lights of 10 ampères; and M. Pieper, 40 arc lights. It will be noticed that the original scheme of lighting has been considerably reduced.

Electric Lighting of Theatres.—*La Lumière Electrique* publishes an article in which European theatres electrically lighted are enumerated. If the information generally is no more correct than is that particular portion of it which refers to London we are afraid the article does not possess much value. Seven London theatres (including "Olympia") are mentioned, and the Empire, even then, seems to be reckoned twice over, once as a theatre and again as a "hall." As a matter of fact, there are 10 theatres and music halls, not reckoning Olympia, illuminated by electricity in London, as a note in our issue of April 27th sets forth. According to the article there are 13 theatres in Paris possessing installations of the electric light, and 11 more in other parts of France; 2 in Spain, 1 in Belgium, 13 in Germany, "several" in Denmark, Sweden, Norway, Austro-Hungary, Italy, and Russia, and 1 in Finland.

Theatre Lighting in Spain. — The La Comedia Theatre of Madrid has been supplied with a Collet tubular boiler, a Daeval vertical high-speed engine, and two Schuckert dynamos of 75 ampères and 105 volts. The theatre is fitted with 450 Siemens and Halske glow lamps.

The Electric Light and Fire and Life Risks in America.—In the issue of *Industries* for May 25th, there appears a communication from an occasional correspondent to that journal, which is worthy of perusal. Attention is called to the condition of the overhead wires of the arc lighting companies in New York city, and if the information is to be relied upon the state of affairs is certainly deplorable. We read that the majority of these overhead wires are insulated with what is known as "underwriters' wire," where the covering consists of two or more layers of cotton braid impregnated with whitelead. Under the influence of sun and rain this insulation, never good, has decayed so that numberless places occur where the wires are actually bare. The joints have been covered with a so-called insulating tape, which was originally good, but under competition, cheapness being the great desideratum, it has so deteriorated in quality as to be, as at present manufactured, altogether worthless. The growth of business and the cutting down of prices has brought about the employment of inefficient workmen, aptly called "wire butchers"; proper mechanical training is neglected and there are but few competent instructors. When accidents to life and property occur, and they are becoming only too frequent, the object sought is not to remedy the defective system, but to throw the blame, if possible, on something or somebody unconnected with the particular enterprise.

Proposed Lighting at Folkestone.—At last, after being discussed for several weeks by a Committee of the Folkestone Corporation appointed for that purpose, it has been decided that it is desirable to try as an experiment for three years to light the Lees Promenade by the electric light. So far, the Committee have been successful in their operations, and the matter was subjected to a long discussion in the Council Chamber. The opinions, however, were pretty equally divided, although it was shown that there was a greater amount of support to the introduction of the light than had been found at previous discussions. Eventually it was agreed that the matter should be allowed to stand over for a fortnight, in order that certain questions might be considered.

Tenders for Electric Lighting. — Tenders and descriptions are invited for an electric light installation for a new weaving shed at Ribchester, near Blackburn. For particulars apply to Mr. J. Bertwistle, F.S.I., architect, Tacketts Street, Blackburn, where tenders must be sent by June 9th.

American Telephone Litigation.—The United States Supreme Court on May 14th refused to grant the application for a re-hearing of the telephone cases. The application was made by the People's and Overland Telephone Companies, who claim that Drawbaugh and not Bell was the first inventor of the telephone. Justice Miller, in announcing the decision, said that as none of the three justices who had concurred in the opinion of Chief Justice Waite in upholding the validity of Bell's patent had requested a re-hearing, and that it was the settled rule of the Court not to grant re-hearings unless this were done, the application must be denied.

Long Distance Telephony.—The attempt made last week to communicate by telephone between Marseilles and Dijon, a distance of nearly 500 miles, was completely successful. The experiments between Marseilles and Troyes, a distance of about 620 miles, were, however, not so fortunate; but they are to be repeated after a thorough overhauling of the lines.

Telephonic Communication in France.—The subscribers to the telephone in Paris can now communicate from their houses or places of business direct with the subscribers in Havre, Lille, and Brussels, and *vice versâ*. The charge is 50 francs per annum, plus a tariff of 1 franc per five minutes' conversation between Paris and Lille, Rouen, Havre, and Reims, and of 3 francs between Paris and Brussels.

The Telegraph Clerks' Association.—The seventh annual conference of the United Kingdom Telegraph Clerks' Association was held at Leeds on Saturday, under the presidency of Mr. Plackett. The report showed that the association's financial condition was much improved, the balance in hand being nearly £1,500, and there were between two and three thousand members. It was resolved to reorganise the insurance branch on the basis of reducing subscriptions from 6d. to 2d. per week. The officers were re-elected, and the invitation of the Bristol staff to hold the next conference in that town was accepted.

Breakage of Telegraph Poles.—A serious accident occurred on Saturday on the Cornwall railway, near St. Austell station. A gang of men were employed in transferring telegraph wires from old posts to new. The wires on the insides of the posts had been refixed, and the outside wires were being removed, when the old posts broke off and fell over the embankment, carrying with them two men named Rogers and Stapleton, who were on the posts at the time, to a distance of nearly 60 feet below. Fortunately both escaped with their lives and without sustaining any fractures, but they were severely shaken, and remained for some time in an unconscious condition.

Interruptions and Repairs to Cables and Land Lines.—

	Interrupted.	Repaired.
Land line.—Boussé-Nijné Bielitzowo (Siberia)	27th April ...	27th April
Cable.—Hong-Kong-Haiphong ...	28th „ ...	30th „
„ „ „ ...	7th May ...	11th May
Land line.—Akyab-Rangoon	30th April ...	1st „
Cable.—Hong-Kong-Saigon	28th „ ...	7th „
Cable.—Bulama-Bissao	2nd May ...	Still interrupted
Land line.—Albazine-Ignachino (Siberia)	9th „ ...	15th May
Cable.—St. Vincent-Barbadoes ...	12th „ ...	22nd „
Land line.—Saigon-Bangkok	15th „ ...	Still interrupted

The Antilles Cables.—It is rather remarkable that no news of the ss. *Roddam* has been lately published. She has now been absent six months, ample time, one would have supposed, for the laying of somewhat under a thousand miles of cable, and there does not appear to be any immediate prospect of her return home. All sorts of rumours are current with regard to the detention of the ship in the West Indies, the most plausible being that very extensive repairing work has to be undertaken. Very little reliance, however, can be placed on vague reports, which invariably exaggerate any mishap that may have befallen an expedition. The most serious obstacle to the completion of the work appears to have been the refusal of the authorities to grant the expedition landing rights on the island of Cuba. This, if landing powers have not been since given, would indeed be a grave misfortune, as the cable system would find itself completely cut off from telegraphic communication with the rest of the world—one extremity being isolated at La Guayra (Venezuela), and the other, in the same position, at the island of Hayti, Santo Domingo.

Italian Cables.—The cable between Naples-Ustica-Palermo recently laid by the firm of Pirelli and Company, of Milan, is composed of two sections. The first portion, between Palermo and the island of Ustica, was laid on the 26th January, and is about $36\frac{3}{4}$ nautical miles in length. The second portion, between the island of Ustica and Naples, was laid on the 25th of March, and is about $177\frac{3}{4}$ nautical miles long.

Fatal Accidents from Electricity.—Two fatal accidents occurred at Halifax, Nova Scotia, at the beginning of last month, the cause being the recklessness of the victims, two patrolmen of the Chandler Electric Light Company. Having to examine lamps which were not burning properly, the men appear (at different times) to have climbed the same pole and thrown one leg over one of the arms, on which ran the return wire of the lamp circuit. This wire should, of course, have been thoroughly insulated, but it was not, having four bare places on it; moreover, Captain H. E. Rawson, R.E., who gave scientific evidence at the coroner's inquest in the second case, demonstrated that a heavy shower of rain would completely destroy the insulating qualities of the material with which the wire was covered. Whilst sitting on this wire the second victim (and the first presumably perished in the same way) is supposed to have brought himself accidentally into circuit by touching some part of the lamp with a metal button attached to the glove he was wearing. The evidence showed that he and all the men had been specially warned not to place their legs across the projection of the pole, but the jury returned a verdict equivalent to that of "accidental death," censured the Chandler Company for not having taken sufficient precautions after the first fatality, which took place 48 hours earlier, to prevent a recurrence of the accident.

The Phonograph.—Mr. E. T. Gilliland, whose name has long been known in association with that of Mr. Edison, recently gave an exhibition and lecture upon the latter's phonograph at the New York Electric Club. A great deal of interest was taken in the event, and many eminent Americans were present. The ingenious instrument has undergone vast improvement since its first introduction to an amazed world, and was shown to be now capable of adaptation to many purposes, both of business and amusement. A compositor set in type direct the communications from the phonograph; an operator type-writer performed a similar task, and music and funny stories were sent in and drawn out of the new wonder—for new it is, after the years of neglect it has experienced. In its first forms it was scarcely adaptable to commercial uses; but as it is at present constructed, very large sales are anticipated.

Electropathic Belts.—Mr. Jerritt writes just as we are going to press:—"Dear Sirs,—I have just received the following further communication from Mr. Harness which will no doubt amuse you:"—

Sir,—In answer to your letter of the 24th inst., we beg to inform you that the word "electropathic" is our registered trade mark, and cannot be legally used by any other person in connection with the designation of appliances for electrical treatment of disease. You deliberately, and with evidently a full knowledge of what you were doing, made use of our trade mark to associate with the name of a person in such a manner that it was intended to damage this company, and your reference to the obscure paper you name also leads us to suppose that you are inspired from the same source as the scribe who was discredited by the reproduction of a letter of his we hold prior to his discharge from the service of this company. Unless, therefore, we receive an apology, we shall commence proceedings against you, and our solicitor will take such measures for the delivery of the writ as he may deem necessary.—Yours faithfully,

C. B. HARNESS, *Managing Director.*

Mr. J. Jerritt.

[Mr. Jerritt suggests that the allusion to the obscure journal is evidently intended for the ELECTRICAL REVIEW, and that of the "scribe" for our correspondent, Mr. Lynd. Perhaps the REVIEW is obscure to Mr. Harness, but we may yet make it clearer even to him than he will care to see.—EDS. ELEC. REV.]

Erratum.—In Mr. Gilbert's article "On a new system of Survey and Construction for Railway Telegraphs," published in our issue of May 18th, the description of the locking stick should have been "jointed," and not "pointed."

Tavener's Coulomb Meter.—Mr. Tavener writes to us as follows:—"As a letter appeared in your columns last week calling attention to a paragraph in the American Notes of the *Electrician* crediting Prof. Elihu Thomson with being the first to utilise the heating effects of the current in conjunction with the differential thermometer, for the purpose of measuring and registering the quantity of current passing in a circuit, I feel that I cannot leave the vindication of my claim of priority in that application entirely to others, and may add to what your correspondent has stated that had there been no patent to fix the date of my prior claim I could have brought ample testimony that I had been some time prior to 1884, the date of my patent, experimenting on the heating effects of the current, with the object of constructing an electric meter, as it appeared to offer the only means of making a generally useful instrument applicable to both alternating and direct currents, and which resulted in the adaptation of the tube terminating in bulbs to that purpose, as the only solution of the difficulties of using the heating effects of the current in the way I have with a variable surrounding atmospheric temperature and pressure."

Important Orders for Electric Light Machinery.—The following appeared in the *Leeds Mercury* of the 30th ult.:—Our Wolverhampton correspondent telegraphs:—Large orders were placed yesterday at Wolverhampton for electric light machinery. The company just formed at South Kensington for supplying electricity against gas has placed the contract for dynamos, exciters, secondary generators, regulators, meters, &c., with Messrs. P. Elwell-Parker & Co., Wolverhampton; the engines with Messrs. Fowler & Co., Leeds; and the boilers with Messrs. Babcock, Wilcox & Co., Glasgow. The orders are valued at many thousands of pounds. This plant will supply 7,000 lights. 20,000 lights are ultimately contemplated. Other orders are quickly expected. The works are very busy, running day and night.

The Copenhagen Exhibition.—This exhibition was opened on Friday, May 18th, by the King, Queen and Royal family. The first half of the main building, which is about 900 feet long and 250 feet wide, contains the Danish, Norwegian, and Swedish exhibits of art and industry in all its branches; the other half is devoted to the German, the French, the Russian, the English, the Italian and the Japanese. Besides the main hall there are several smaller and detached buildings spreading over an area of about 50 acres; the principal of these separate departments is the Machine and Engineering, Army and Navy, Gardeners, Hygienic, Fisheries, Agricultural, Dairies, and Foresters. Amongst the exhibits belonging to the Machinery department, are some fine compound and shunt dynamo machines by Prof. Jürgensen, by Edison (Berlin company), by Schuckert, by Hauberg, by Otzen and Tharstensen (Siemens & Halske's agents), of Copenhagen, and by Palmcrantz & Co., of Stockholm, all these are at work and illuminating the grounds and different departments every evening. There are further some exhibits of interest in the telephonic line, and as to telegraphic and testing instruments, there is a splendid display by the Great Northern Telegraph Company of all the different kinds of apparatus employed for working the company's cables and land lines, also several sets of testing instruments for use on board a cable steamer, in a cable house, and in a telegraph office, all of which are the company's own manufacture. In future issues we hope to treat of many of these exhibits in detail, and also to describe in particular the electric light installation of the Exhibition.

The Royal Society.—At the meeting yesterday (Thursday) a paper by Dr. J. Monckman "On the Effect of Occluded Gases on the Thermo-electric Properties of Bodies and on their resistances: also on the Thermo-electric and other Properties of Graphite and Carbon," was down to be read.

Connecting Western Australia and India by Cable.—Messrs. Millar Brothers, contractors, have announced that they are prepared to lay a submarine cable from a point on the north-west coast between the North-West Cape and Cambridge Gulf, to connect the telegraph system of Western Australia with that of the Indian Government should the Western Australian Government allow the following concessions:—To grant the sole right to construct and work this cable, and to allow a rebate of 25 per cent. on the ordinary rates from all messages passing over Western Australian wires between Europe and the eastern colonies. They were prepared to carry out and complete the undertaking within a period of two and a half years from date of the concession being granted. This cable would be the shortest route between the eastern colonies and Europe; it would avoid the shallow waters and coral formations which have proved a source of so much trouble to the more eastern line, and would also possess the great advantage in the event of a European war of passing entirely through British territory.

The Affairs of Mr. Volk.—A special sitting of the Brighton County Court was held on Thursday to resume the hearing of a motion *in re* Volk, the proprietor of the Brighton Electric Railway. Mrs. Hamilton, a lady of large means residing at Brighton, had tendered a proof for £1,539 12s. 8d., for money lent and interest, the original amount borrowed being £1,500. On February 12th a meeting of creditors was held, when the Official Receiver (Mr. A. Mackintosh) rejected the proof on the ground that the money she had advanced was lent on the terms of sharing profits in the railway, and that under Section 5 of Bovill's Act she was not entitled to move in competition with other creditors. Mrs. Hamilton now moved the Court to reverse the decision of the Official Receiver, or to declare her to be entitled to three-twentieths of the value of the railway. Mr. Mackenzie (for the Official Receiver) raised the question as to the jurisdiction of the Court, but Mr. Rutherford (representing Messrs. Miller, Peal & Co., of Liverpool) contended that his Honour had power to deal with the question. If the matter could be disposed of now he would be willing to abandon right to prove and come in as a co-owner or partner. After hearing the arguments, his Honour said that the matter came before him in a peculiar manner. A receiving order had been made against Mr. Volk, but it was still undecided whether there should be a bankruptcy or whether a composition could be arranged on certain terms. By the agreement between the debtor and Mrs. Hamilton, the former agreed to expend the money borrowed for business purposes, and to pay interest according to the receipts. Mrs. Hamilton agreed to take shares in the railway, either party being at liberty to give six months' notice, Mrs. Hamilton to demand repayment and Mr. Volk to pay her out. If the property were reinvested in the debtor, Mrs. Hamilton's rights would remain the same under the agreement. He did not consider it necessary to make any order to protect those rights, and as no trustee had been appointed he did not consider that he should determine the position of the parties. All he should decide was whether or not Mrs. Hamilton had the right to prove as a creditor, and he should say not. If a creditor she was only a creditor within the liabilities of Bovill's Act, and he therefore refused the application with costs.

Demagnetising Watches.—Mr. G. Franke informs us that he also is prepared to undertake the cure of watches which have become magnetised, and that for the purpose they may be sent to Mr. Binswanger.

Extending Business.—Owing to the rapid increase in business, Messrs Elwell-Parker have lately made several extensions at their works and are adding considerable additional engine power.

Electric Light Fire.—Fire on the night of April 25th destroyed the plant of the electric station of the Edison Company situated at Fall River, Mass. Early in the evening there had been trouble with one of the engines, and lights about town had burned with great brilliancy and then died down to almost nothing. The engineer, Charles B. Gardner, at 11 o'clock was standing near the door, when a sheet of flame darted up the south-east end of the building. He and the fireman had only time to save their lives by jumping, and in a second, "like the cracking of a snap match," the whole building was in a blaze. "Short circuit," according to the characteristic report of the American paper from which we extract the information, "did the business; but what caused the short circuit nobody seems to know. The station was a brick, one-storey structure, and the four walls are standing. The plant consisted of six dynamos, valued at $4,000 each, which are destroyed, and three engines, worth $1,000 apiece, which can be repaired at comparatively slight cost. Loss probably $30,000; insured for $20,000 in mutual companies. The company had 4,200 lights on its lines, and there is a big trade in lanterns in the city to-day. Guests at the Harvard ball, the social event of the season, were left with a few gas jets and a lamp or two, but they finished the programme just the same."

Bath and the Electric Light.—At a meeting of the Bath Town Council on Tuesday, the recently-appointed electric lighting committee brought up their report, and the Chairman (Mr. Sturges) moved that the Council instruct the committee to obtain tenders for lighting a central area by electricity. He said he had ascertained from Mr. Massingham that the probable cost would be half as much again as they were at present paying for gas lighting; several of the leading citizens were willing if necessary to form a local company for supplying the light at the lowest cost of production. Mr. Cox moved as an amendment to add to the resolution the following clause: "And that the committee invite the gas company to tender for supplying a better light than they do at present." On the amendment being put only 6 voted for it. The resolution to advertise for tenders for electric lighting was then put and carried unanimously.

New England Electric Exchange, Boston, Mass.—As a result of various conferences held between gentlemen interested in insurance matters and others engaged in electrical business, at which the matter of diminishing risks to property and life by a more thorough installation of electric light and power plants and the employment of the most competent men for their operation were discussed, the New England Electric Exchange has been formed, and a constitution and plan of licensing adopted. The Fire Underwriters have undertaken not to insure any property where electric light or electric power is used, nor pass any new installations, unless the party operating the plant or making the installation has obtained from the exchange a certificate of licence.

Fatal Explosion of a Gasometer.—At the Montreal Gas Works last week a gasometer exploded, killing several people.

Signalling by Balloons.—An electrical war balloon was exhibited at the Whitsuntide Gala at Bedford last week. The balloon was of the type supplied to the English and Belgian Governments, a specimen of which has not been before exhibited in the provinces, and was under the personal superintendence of the inventor, Mr. Eric Stuart Bruce, M.A., Oxon, F.R. Met. Society.

French Telegraph Receipts.—The receipts for the month of April of the French Telegraph Department have exceeded the estimated returns by 256,000 francs.

Students Papers.—At the students' meeting of the Society of Telegraph-Engineers and Electricians, on Thursday, June 7th, Prof. J. Perry, D.Sc., F.R.S., in the chair, the following paper will be read:—"Belts and Belt-Driving for Dynamos," by J. N. Cooper.

Cricket.—The *employés* of the Electrical Power Storage Company have formed a club among themselves, and the inaugural match came off with great success on their ground at Lordship Lane, Dulwich, last Saturday, between the secretarial and engineering departments, the former being victorious. The club, we understand, is open to receive challenges from electrical and other engineering firms and societies.

Decorative Mouldings.—Mr. Samuel Elliott, of the Albert Moulding Mills, Newbury, which is one of the largest concerns of the kind in the country, is issuing a series of pattern books, No. 5 of which is just published containing sections of high class mouldings suitable for cabinetmakers, builders, and decorators.

Conversazione at Finsbury Technical College.—The annual *conversazione* of the students of this institution took place on Friday evening last, May 25th. The programme included a well arranged concert and interesting lectures by Prof. Silvanus Thompson and Prof. Perry. The exhibition of apparatus in the classrooms was particularly good and included the new instruments described by Sir W. Thomson the previous evening at the meeting of the Society of Telegraph-Engineers. The Edison-Swan Company showed the Swan miner's lamp in operation, and Mr. Bernstein his new system of domestic lighting. Messrs. Cockburn and Day had a large number of exhibits including not only their specialties in cut-outs and switches, but almost everything coming under the head of electrical fittings. One of the most interesting exhibits was an illustration of the fireproof system of theatre lighting invented by Messrs. Sudworth and Berry. The Electrical Power Storage Company lent valuable aid in the way of exhibits and also lighted one of the rooms. Messrs. Paterson and Cooper, the General Electric Company, the Electric Apparatus Company, the United Electrical Engineering Company, and several other firms were also represented. The attendance as usual was very large, and the whole proceedings in every way most successful.

Telegraphic Communication between Lighthouses and the Shore.—This question again arose at a meeting of the Plymouth Chamber of Commerce on Monday, when it was announced that Sir George Baden-Powell had given notice of a motion in the House of Commons, and had intimated that he was willing to co-operate with them in the matter. An offer of similar assistance had also been received from the National Lifeboat Institution. Mr. Bayly, in the course of a brief address, said that they would have to bring some pressure to bear on the Treasury, so that they might make them see that, although the establishment of the proposed telegraphic communication between lighthouses and the shore might possibly involve some unremunerative work for the Post Office, yet that any such departmental loss would be more than compensated for by the saving of life and property and the facilities afforded to British industry. In Denmark and Sweden almost every lighthouse was in telegraphic communication with the shore, the lighthouse keepers acting as telegraph clerks, while the lifeboat stations were telephonically connected. Last winter a derelict ship was drifting for nearly three days within sight of Eddystone Lighthouse, but it nearly became a wreck because there was no means of sending for help. A great deal might also be said with regard to the importance of such telegraphic communication in case of war. The Secretary of the Chamber said that the interviews which they had had in London convinced them that it was hopeless to expect the Post Office to take the matter up, unless expressly ordered to do so. In London, the matter was looked upon as important from the point of view of national defence. Eventually the further promotion of the views of the Chamber was left in the hands of the committee.

Forthcoming Publications.—We learn that a fourth, thoroughly revised and enlarged edition of Sir D. Salomon's book on the "Management of Accumulators," will be published shortly. The third edition having sold within a few months, the book has been out of print for some time. Messrs. Whittaker & Co. will publish a second edition of "Leland's Practical Education," which was reviewed in our columns a short time ago, and a second edition of Bottone's "Electrical Instrument Making for Amateurs." Preece and Maier's work on "The Telephone" they hope to have ready during the next month.

Copper.—The *Financial News* of Tuesday said: "The copper market is beginning to exhibit precisely the same phenomenon which presaged the fall in tin. Chili bars were quoted 81½ to 82 on the spot yesterday, and 74 to 76 for three months delivery, which means that the price is expected to give way within that period. No one who follows the science of financial meteorology can have two opinions on that."

Edison's Inventions.—According to the *New York Herald*, "it has been learned that many of Edison's most valuable inventions have been lost to the world through the avarice of that grasping monopoly—the Western Union Telegraph Company. It is stated upon good authority that the company pays Edison a yearly retainer for the privilege of having the right to purchase all his inventions at a price mutually satisfactory. In the relations between Edison and the Western Union Telegraph Company the world has seen scientific developments of the utmost importance to mankind going through the forms of the Patent Office, then handed over to the telegraphic leviathan and simply buried out of sight, for the reason that either the utilisation of such inventions by the company would involve expense and menace dividends for a time, or because a higher profit could be derived by the partial or entire suppression of the invention. One of Edison's most important inventions was the automatic system of telegraphy, by which 300 words a minute could be easily transmitted over wires. In order to utilise it the Western Union Company would have to alter all its instruments, and this is the reason that the great invention is now locked up and lost so far as the present generation is concerned. The Electro Motograph system of telegraphy, invented by Edison to transmit a thousand words a minute, is also locked up. The company holds many more minor patents which it thinks more profitable to suppress than to use. This is nineteenth century progress."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Extended Electro-Metal Extracting, Refining and Plating Company, Limited.—The statutory return of this company made up to March 15th was filed on April 16th. The nominal capital is £150,000 in £1 shares. 1,670 first preference shares are taken up, and the full amount has been called thereon. The calls paid amount to £907 10s. and unpaid to £762 10s. Registered office, 2, Metal Exchange Buildings, Gracechurch Street.

Engine Company, Limited (mechanical and electrical engineers).—At an extraordinary general meeting of this company held at 9, Victoria Chambers, Westminster, on March 8th, it was resolved to wind up voluntarily. The resolution was confirmed on March 23rd and duly filed on April 4th.

Railway Train Telegraphy Company, Limited.—The statutory return of this company, made up to the 7th April, was filed on the 10th April. The nominal capital is £3,000 in £1 shares. Nine shares are taken up, and the full amount has been called and paid thereupon. Registered office 11, Queen Victoria Street.

Taylor and Tucker, Limited (Manufacturers of Electric Bells, Art Metal Work, &c.).—The statutory return of this company, made up to the 12th April, was filed on the 17th April. The nominal capital is £20,000 divided into 16,000 ordinary and 4,000 preference shares of £1 each. The shares allotted are 1,000 ordinary and 3,652 preference, upon which the full amount has been called. The calls paid amount to £4,614 10s. and £37 10s. is considered as paid. Registered office, 41, Berwick Street, Soho.

British Association of Medical Electricians.—The registered office of this company is at 39, Hatton Garden, and the secretary is Mr. H. C. R. Sharman.

General Zinc Recovery and Lighting Company, Limited.—The registered office of this company is at 50, Holborn Viaduct.

CITY NOTES, REPORTS, MEETINGS, &c.

Oriental Telephone Company, Limited.

THE adjourned eighth annual general meeting of this company was held on Friday last week at the City Terminus Hotel.

Mr. B. St. John Ackers presided, and in moving the adoption of the report stated that in preparing the accounts for the annual meeting on the 25th ult., they decided that until the Indian guarantees expired it would be better to keep the balance sheet in the same form as before. Just prior to the annual meeting, however, the board received an opinion of counsel respecting the legality of the payment of dividends by the former directors, and thus, unexpectedly, the question arose as to whether the dividend now recommended of 2½ per cent. on the paid up capital other than the vendors' shares could be paid. There was no other course but to adjourn the last meeting, but the directors had since taken the opinion of their legal adviser, as well as that of the company's auditor, and also that of an eminent accountant unconnected with the company, and they had been confirmed in their opinion that the assets were fully equal to the liabilities, and that the proposed dividend might be paid. His prediction at the last meeting had thus been verified; but it had been necessary to recast the balance sheet, the revenue and profit and loss accounts, however, remaining unaltered. The patents and goodwill account had been written down by £42,990, and that item now stood at £71,000. Lower down on the asset side of the balance sheet it would be observed that the deferred shares had been brought up and valued altogether, and the various sums had been carried out into one total. Now that the guarantees had expired there would be no deferred shares in connection with the Indian companies; and the items of "shares and debentures in subsidiary companies" had been written up from £45,760 to £89,115. The total of the balance sheet now came to £209,432 against £209,067 as shown in the balance sheet submitted to December 31st last—in other words, after the assets had been carefully valued and rearranged, it was seen that they were amply sufficient to meet all liabilities, with a small profit over of £365, thus increasing the item, on the other side of the balance sheet, of sundry credit balances to £2,239. He therefore thought the shareholders would consider that the directors were justified in recommending the proposed dividend, and he believed that the distribution next year would be sensibly increased. At the same time, it would be very unwise to divide everything, for they had no reserve fund, and they had no way at present of obtaining any extra working capital except by making a call on the shares. The vendors' shares amounted to £75,000, and were at present nominally £1 paid, while the other shares of £1 each had 11s. paid. He trusted it would be possible by some means to make an arrangement by which the vendors' shares should be reduced in amount, the liability on the other shares extinguished, and the vendors' shares rank very soon for dividend. If such an arrangement could be arrived at, the shareholders would be a united body, and he was sure that that would be greatly for the benefit of the company. He was glad to state that an agreement had been come to by which the company's rights over the whole of Australia, New Zealand, and Tasmania were recognised, and by which they would also receive an annual amount in royalties. The one reason why they had not obtained all that they ought to have obtained was that the Melbourne exchange had been purchased by the Colonial Government.

The Right Hon. G. Cavendish Bentinck, M.P., seconded the motion, which was unanimously adopted; and resolutions were afterwards passed declaring the dividend mentioned and re-electing the retiring directors and auditors.

Electrical Automatic Delivery-Box Company, Limited.

THE first ordinary general meeting of this company was held at Winchester House, Old Broad Street, E.C., last week, Mr. J. W. Cooper presiding.

Mr. L. W. Balck, the secretary, having read the formal notice convening the meeting,

The Chairman said: We are pleased to be able to call the shareholders together to state what we have done so far as we have gone, and we are required to call you together under the statute. We consider that the patent is an extremely valuable one, and we have several designs for boxes which you will see on the windows and pillars round the room. The shareholders may, perhaps, wonder that there has been any delay at all in proceeding with the manufacture of boxes, but we had been advised by the consulting patent agents not to send in our final specifications until certain other specifications had been filed. We have since sent in our final specifications, and have received an intimation unofficially, which will undoubtedly be confirmed, that they have been accepted; and now we shall be able to proceed with the manufacture of boxes without any further delay.

Mr. Lambe said, as a shareholder, he considered that the directors had acted wisely in delaying the filing of the final specifications. Mr. Villiers Stead, the inventor, had told him that morning that the Patent Office had accepted their specifications. The next duty that devolved upon the shareholders under Schedule A of the Act was the election of directors, and he took the liberty of proposing the re-election as a director of Mr. J. W. Cooper.

Mr. J. Jones seconded the motion, which was carried unanimously.

The Chairman, in acknowledgment, said he should be very glad to do all in his power, as he had done hitherto, to advance the interest of the company. He proposed the re-election of Mr. G. P. Simpson, who had been on the board since the company's existence, and done very valuable service.

Mr. Dale seconded the motion, which was carried.

Mr. Jones asked how many shares had been allotted.

The Chairman: In all, 30,446.

Mr. N. E. Maltass and Mr. Deakin were also re-elected on the board.

Mr. Deakin said there was one little matter which the chairman had omitted to mention. Mr. Stead stated to him that he had sold the American patent for a much larger sum than the English one. This showed the value that was attached to the invention by our "American cousins."

The Chairman said there was room for another director, and it was open for the shareholders to propose someone if they chose, and he would take the necessary legal steps to put that director on the board.

Messrs. John Ellerman and Company were unanimously reappointed the auditors of the company.

A Shareholder: Are the patent rights quite secure; because there has been some rumour about them?

The Secretary: I am very pleased to say there is no question whatever about the matter, and you have been misinformed. The only delay was in consequence of our being asked not to file our final specifications for a time, to which we agreed.

Mr. Stead said he went over to the Patent Office that morning, and was told that with some slight alterations, which would be made, the specifications had been accepted. They had received what he considered the master patent—the German one—which was the most difficult to be obtained in the world.

In answer to a question, the secretary said applications had been received from various sources for upwards of 4,000 boxes.

The proceedings closed with a vote of thanks to the chairman.

Hastings Electric Lighting Company, Limited.

THE annual meeting of this company was held last week at the Works, Hastings, Mr. H. M. Baker, J.P., presiding over a small attendance of shareholders. The directors' report for the year ending March 31st was published in the REVIEW for May 18th.

The Chairman, in moving its adoption, said the company had had a difficult matter to carry on the business. They had had difficulties on three accounts, and amongst them they might fairly charge one to that large monopoly, the Gas Company. Then again the Town Council, in which there were some gas shareholders, had shown them opposition, but fortunately there were some members who had shown a public spirit, and helped them in their undertaking, and a portion of the front line of Hastings and St. Leonards was better lighted than almost any other town in the kingdom. He had to acknowledge the assistance of the Council in sanctioning overhead wires, but whether this plan would be adopted was a question requiring considerable attention on the part of the company. They had succeeded in getting the rate of interest on the overdraft reduced, and had raised £1,000 by debenture bonds amongst the shareholders. But for the assistance of large shareholders in taking up these bonds the directors would probably have given up. With this assistance fortunately they had been able not only to increase the receipts but keep the expenditure much the same as last year. The expenditure had been somewhere about £14,000, and the capital only about £7,000, and the reserve fund £2,998. They were encouraged to go on and were satisfied that if sufficient capital was invested in the electric light

with the increased knowledge science was bringing to bear upon it, it must in the near future. But they were not in a position to spend money because they had not got it, and therefore could not develop their system sufficiently, and he thought they might fairly await the experiments which were being made in different parts of the country, and then the difficulty of the electric light, he alluded to the storage batteries, would be solved. They could really have paid four per cent. but did not think it wise to do so, and had carried forward the balance. They might further have suggested that £100 be paid to the directors for their six years' services, but were so modest that they would not do so.

Mr. W. Slade seconded, and the report was agreed to.

Mr. A. Bray moved the re-election of Messrs. J. Reeves, sen., F. A. Langham and J. Woodhams as directors. He suggested that if the price of the light was reduced a greater trade might be done.

Mr. Langham, in acknowledging his re-election, said the shareholders were indebted to the secretary and engineer for the economising that had produced the result obtained this year. The report was more satisfactory than it appeared, in fact, taking everything into consideration, six per cent. could have been paid. They must endeavour to secure a larger amount of capital to extend their mains westward or establish another centre in that direction before they could extend the business. The present power was the highest they could obtain, and more work could not be done with it. He believed there was a custom waiting as soon as they could supply it.

The auditors having been re-elected, the meeting closed with a vote of thanks to the chairman, who replied to Mr. Bray's suggestion by endorsing the remarks of Mr. Langham.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 25th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,306.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

AN ordinary general meeting of this Society was held on Thursday, May 24th, Mr. E. GRAVES, President, in the chair. The formal business of the meeting having been transacted, a paper was read by Sir WILLIAM THOMSON, F.R.S., Past President of the Society, on "New Standard and Inspectional Electric Measuring Instruments." The author commenced by stating that all the instruments to be referred to were dependent in their working upon the Ampèrian action. In the milliampèremeter the addition of a platinoid resistance enabled the instrument to be converted into a voltmeter. In the Marine Voltmeter which he would first describe and which was the instrument which was not dependent in its working upon the Ampèrian action, there were two coils, and between the latter there was placed a soft iron oblate spheroid, the latter by Faraday's law would, when acted upon by a current, tend to turn its major axis in a line with the magnetic lines of force. The value of the turning force was proportional to the square of the current; the instrument being in this respect unlike that of Ayrton and Perry, where the action was nearly directly proportional to the current. The oblate spheroid was fixed on a stretched platinum wire kept taut by means of a spring like a coach spring, and differing only from the latter in so far as it was not hinged but was a continuous band. The elastic action at the bends (corresponding to the hinges in the ordinary coach spring) formed part of the active principle. The platinoid wire was kept stretched to about one-third of its breaking strain. The instrument he exhibited had only a short range, viz., from 90 to 110 volts. The needle did not start from zero, as it was found that if the latter were used a set took place which took some time to creep back. One of these instruments, which had been in use for a year, was found correct within one-fifth per cent. at the end of that period. In the more recent form of the instrument it could be set to zero, and had a range of 90°. The original instrument was more useful as a standard than as a quantitative instrument. The oblate spheroid was liable to take up permanent magnetism when the coils were traversed by strong currents; to get rid of this a small hard commutator was attached which on being rotated sent reversed currents through the instrument which wiped out the magnetism. The apparatus would then reproduce the same readings exactly. This instrument had been used in an electric light installation on board ship with entire success and had saved many lamps. The next instrument to be described consisted of two movable coils at each end of a lever, these movable coils each playing between two fixed coils; the mutual action of these coils tended to move the lever and the action was counteracted by means of weights which indicated the current strength. The apparatus had a slate base and the coil cheeks were of the same material. The instruments were made in several sizes, the centiampèremeter having a range of from 1 to 50, and the deciampèremeter a range of from 2 to 100. The accuracy of the meters was very great; one which had been broken when sent to Belgium, after being repaired, was without further adjustment found to be correct within $\frac{1}{20}$th per cent. The kiloampèremeter would measure from 50 to 2,500 ampères; in fact, the total range of the entire set of instruments ranged from $\frac{1}{100}$th of an ampère to 2,500 ampères. In the kiloampèremeter the flexible connections consisted of 900 fine copper wires.

In the discussion which followed the reading of the paper,

Mr. W. H. PREECE said that few members could boast of the experience which he himself had had; he had assisted Faraday in his experiments on lateral induction in underground wires, and more than 30 years ago he had learnt the use of the differential galvanometer made by Siemens, and later on he had used those of Thomson; he would assert that to those two physicists the possibility of accurate measurements was due. He considered that electrical instruments were more accurate than any other class. Attention to details was of the greatest importance, as Sir William Thomson had said. The meeting was much indebted for the clear descriptions given.

Dr. WERNER SIEMENS having said a few words,

Prof. W. E. AYRTON said he had not had any actual experience of Sir William Thomson's instruments, and he could not, therefore, criticise them. He, in conjunction with Prof. Perry, had made an enormous number of experiments towards producing satisfactory measuring instruments, and he would point out that to design an instrument on paper was one thing, but to make it successful was quite another thing, as unexpected difficulties continually cropped up. He would ask how the difficulty of the oxidation of platinoid had been got over. The electrometer of Sir William Thomson had proved to be a wonderful instrument for several purposes; by its means the action of paraffin oil on zinc could be detected, as it set up an electromotive force which the electrometer showed, whereas the most delicate chemical tests failed to show that there was any action.

Prof. FORBES made a few remarks.

Dr. FLEMING had found the Thomson instruments to be most satisfactory, and he had the greatest confidence in them. Although the meters looked complicated, they were really very easy to use.

Prof. SILVANUS THOMPSON would ask when we should be able to get measuring instruments which would be correct within $\frac{1}{10}$th per cent., and which could be obtained at a reasonable price. He would point out that an extremely accurate watch could now be obtained for a very few shillings, and he hoped the same would be the case with the electrical measuring instruments.

Mr. SWINBURNE said that a class of instruments on the principle of the Deprez-d'Arsonval galvanometer was coming into use, and was superseding the original mirror form of Sir William Thomson. The new instruments he referred to were, however, practically on the principle of the Siphon Recorder.

Mr. GRANVILLE asked what would be the effect of mechanical agitation on the iron of the instrument which had been described.

Sir WILLIAM THOMSON, in reply, said that he had not found that platinoid oxidised even when exposed to the action of sea water and air, possibly, however, some qualities of the alloy may not be so good as others, he thought the properties of platinoid were well worth investigation. In answer to Mr. Granville he would say that the experiments on Flinder's bars proved that when the latter were not more than 8 or 10 times as long as they were broad, they did not alter when subjected to mechanical vibration.

The meeting then adjourned.

NEW PATENTS—1888.

4673A. "Improvements relating to incandescent electric lamps." P. M. JUSTICE. (Communicated by C. Heisler, United States.) Dated March 27. (*Complete.*)

7479. "Improvements in insulation in electrical machinery and apparatus." F. L. RAWSON and W. WHITE. Dated May 19.

7480. "Improvements in insulation in electrical wire or in its supports or carriers." F. L. RAWSON and W. WHITE. Dated May 19.

7487. "Improvements in electric switches" G. BINSWANGER and H. J. COATES. Dated May 22.

7519. "Improved portable easy chargeable safety fluid battery." E. G. KEMPE. Dated May 22.

7522. "Dynamo apparatus." E. J. HOUGHTON. Dated May 22.

7523. "Means and apparatus for electric lighting." E. J. HOUGHTON. Dated May 22.

7530. "A portable electric safety lamp." E. R. CHITTENDEN and E. E. VAUGHTON. Dated May 22.

7536. "Improvements in galvanic batteries." B. WILLCOX. (Communicated by T. P. Whittier, United States.) Dated May 22. (*Complete.*)

7541. "Improvements in electric machines." W. P. THOMPSON. (Communicated by H. W. Spang, United States.) Dated May 22. (*Complete.*)

7548. "A floating telegraphic or telephonic station or apparatus for enabling ships at sea to communicate with one another or with the shore." U. DIEULEVEULT. Dated May 22.

7551. "Improvements in and relating to coupling devices for electrical and other purposes." J. KENDALL and O. COOPER. Dated May 22. (*Complete.*)

7585. "The combination of telephones with multiple signalling circuits." A. WHALLEY. Dated May 23.

7619. "A primary electric battery." G. J. WEIR. Dated May 24.

7636. "Improvements in holders for electric incandescent lamps and shades." J. APPLETON, W. T. BURLEY, and A. E. WILLIAMSON. Dated May 24.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

3767. "A method of checking or arresting the feed of an arc lamp and appliances for the purpose." J. LEA. Dated March 12. 8d. Claims:—1. An electric arc lamp wherein the feeding of the carbon or carbons is effected by means of clockwork or other motor mechanism controlled by a brake or equivalent device actuated by a magnet or solenoid in a shunt from the main circuit, and wherein provision is made for switching resistance into the said shunt simultaneously with the releasing of the said mechanism, for the purpose specified. 2. An electric arc lamp wherein the current is passed through a brake or equivalent device for controlling the feed-mechanism, substantially as and for the purpose specified. 3. In a lamp of the kind or class described in the first claiming clause, the provision of means whereby the extra resistance switched into the shunt will energise a magnet for counteracting the controlling magnet or solenoid, substantially as and for the purpose set forth. 4. The improved electric lamp consisting of the parts constructed and combined, substantially as described with reference to the drawings and operating as specified.

4070. "Improvements in combined engines and dynamos." M. H. P. R. SANKEY and P. W. WILLANS. Dated March 17. 11d. Claims:—1. The construction of combined engines and dynamos, with the dynamo armature and commutator, with radial bars carried on the overhanging end of the engine shaft and with the field magnets carried in the way shown by girders or brackets projecting from the bed of the engine. 2. The construction of combined engines and dynamos substantially as described and illustrated.

4549. "Improvements in electric incandescent lamps." A. FEATHERSTONHAUGH. Dated March 26. 4d. Claim:—In all electric incandescent lamps where multiple filaments or wires are used, arranging these filaments or wires so that they are close together, whereby a saving of heat is effected and there is an increased amount of light produced to what would otherwise be the case.

5096. "Improvements in dynamo-electric machinery." G. KAPP. Dated April 5. 8d. The inventor constructs the core of disc armatures partly of soft iron wire, and partly of soft iron tape the latter being comparatively narrow, and two tapes being coiled to form the end faces of the core, the iron wire being coiled into the annular trough thus formed. He splits up the magnetic-field into two portions, one excited by coils in series, with and traversed by the armature current, or a definite and constant portion thereof; and the other excited by coils which may be traversed by a variable portion of the armature current, or by a shunt current, or by a current from an independent source, or by a combination of these methods. The claims are 9 in number.

5199. "Improvements relating to the distribution of electrical energy for purposes of locomotion." W. LOWRIE and C. J. HALL. Dated April 7. 8d. The inventors use a conductor of small area to convey high tension alternating currents, or energy, from the source of supply throughout the circuit. One or more low tension conductors, of large area, are used throughout the circuit in which the tractive force is to be applied; but such conductor or conductors need not be electrically continuous. Electrical connections are made between the high tension and low tension conductors at intervals as required; each of the said connections passing through an induction apparatus or electric converter of a suitable kind, and such as we have already described in letters patent No. 10765 of 1886. The claims are 7 in number.

5303. "Improvements in dynamo-electric machines." H. W. RAVENSHAW, W. T. GOOLDEN, and A. P. TROTTER. Dated April 12. 8d. Has for its object the providing of means whereby the whole of the surface, or area, of the periphery of a drum armature may be utilised for the purpose of winding while at the same time allowing of the coils being properly secured in place. In winding an armature according to this invention the whole, or any desired part, of the armature's periphery is covered by the winding, and the respective wires are retained in place by passing them between suitably formed projecting pieces, cast or otherwise formed upon, or attached to, the end pieces of the armature. These projecting pieces are so shaped and spaced apart radially and relatively to each other and to the axis of the armature as to insure their coinciding with the openings left by the intersections of the various coils. There is 1 claim.

5365. "Improvements in acoustic or tone telegraphy." W. T. BARNARD. Dated April 13. 8d. Consists more especially in the combination and arrangement with a number of independent transmitters connected with the line circuit, of one or more acoustic receivers, also connected with the line, and resonater analisers for selecting the independent messages. The claims are 4 in number.

5505. "Improvements in dynamo-electric machines." H. W. RAVENSHAW, W. T. GOOLDEN, and A. P. TROTTER. Dated April 15. 8d. Consists in building up the armature upon a hollow bush, or hub, having a cylindrical opening of a sufficient diameter for a certain portion of its length, to allow of the shaft, together with its bearing, passing into the opening, while for the remainder of its length the opening is of a reduced diameter sufficient only to allow of the shaft passing through it. The claims are 2 in number.

5583. "Improvements in galvanic batteries." H. LIEPMANN. Dated April 16. 8d. Relates to improvements in the batteries described in Patent No. 4,832, 31st March 1887. The claims are 2 in number.

5637. "Electrical controlling apparatus." A. SIEMENS, and E. F. H. H. LAUCKERT. Dated April 18. 8d. The lamps being in the main circuit of the dynamo machine, whilst the field magnets of the machine are in a shunt circuit, the current is regulated by introducing into this shunt circuit more or less resistance, according as there is a smaller or a greater number of lamps or other apparatus in the main circuit. For this purpose the main current is led through the coil of a regulating solenoid having a movable core suitably counterpoised. The core, when it moves in obedience to an increased or diminished attraction of the solenoid, makes one or other of two sets of contacts, bringing into circuit a small electric motor machine the armature of which is thus caused to revolve in the one direction or the other. This armature, by means of suitable gearing, gives comparatively slow rotation to a commutator having its plates connected to a number of resistances arranged in series. A brush or collector bearing on those plates is connected to one of the terminals of the main dynamo machine, whilst the first of the plates is connected to the other terminal through the coils of the field magnets of the machine. The claims are 4 in number.

5709. "Improvements in dynamo-electric machines." A. I. GRAVIER. Dated April 19. 8d. Claims:—1. In dynamo-electric machines, or electro-motors, the use of field magnets, symmetrical or unsymmetrical as to their form, but magnetically unsymmetrical, substantially as and for the purposes above set forth. 2. Constructing field magnets with a plate of wrought iron attached to the cast iron cores, before the coils are laid thereon, as and for the purpose described. 3. Forming the armature at those parts which should be most magnetised, with sharp angles or corners, as described.

5833. "A combined gas motor engine and dynamo-electric machine." F. W. CROSSLEY. Dated April 21. 6d. Claim:—A combined gas motor engine and dynamo-electric machine, wherein the dynamo-electric machine is mounted upon the engine cylinder, and is driven by a belt from the fly wheel strained by a tightening pulley mounted adjustably, substantially as described.

5835. "Improvements in contact makers, especially suitable for connecting wires." D. L. SELBY-BIGGE. Dated April 21. 8d. The contact maker has in it a groove with a wedge fitted into it. The wires which it is desired to connect are placed side by side in the groove, and when the wedge is forced in considerable lengths of them are pressed together. There are 2 claims.

5867. "Improvements in secondary batteries." W. KINGSLAND. Dated April 22. 8d. Claims:—1. In secondary batteries the contact strips or pieces of platinum foil clamped to the anode, with a washer or strip of similar material to the anode, whereby the platinum foil is in contact with active material on each side, substantially as set forth. 2. In secondary batteries the nuts or bolts for clamping the platinum foil contact pieces, in combination with the washers or strips of similar material to the anode, as and for the purposes set forth. 3. In secondary batteries clamping two or more anodes together, with or without a cathode or cathodes between same, having platinum contact pieces in combination with two or more backings of active material, and held or supported by insulated bolts and nuts and elastic washers, and provided with insulating pieces when necessary, all substantially as and for the purposes described and illustrated with reference to the drawings.

6168. "Improvements in or connected with telephones for checking payment for the use of the telephones." H. F. JACKSON. Dated April 27. 8d. At the calling station is the ordinary set of instruments, comprising a transmitter, receiver, and bell (or the like) in connection by the line with the exchange or distant station. At the calling station there is also a receptacle for the coins with a shoot or passage through which the coins pass on their way to the receptacle. In, about or forming part of this shoot is a diaphragm or transmitter in circuit with the line wire or with a battery and the primary of an induction coil, the secondary of which is in the line wire. The said transmitter or diaphragm is so placed that the coins pass in contact with it or with projections on it as the said coins fall through the shoot to the receptacle, and so a sound is transmitted to the exchange or other distant station, indicating that the fee for the use of the telephones has been paid.

6177. "Apparatus for adapting electric lamps to the helmets of divers." A. MARCILHACY. Dated April 27. 8d. Claim:—The combination with a diver's helmet of an electric glow lamp enclosed in a casing or lantern which is screwed on to the helmet in the place of the top bull's-eye, and arranged substantially as described with reference to the drawings.

6294. "Improvements in the electrolytic treatment of zinc and its ores." A. WATT. Dated April 29. 6d. The inventor employs the impure zinc, however obtained, as an anode, and places it in a solution or electrolyte composed of a vegetable acid. He then passes a current of electricity through the liquid, and the zinc becomes rapidly dissolved. In a short time zinc of great purity is deposited upon a cathode or negative electrode, while the surface of the anode assumes a discoloured, or even black appearance, due to the impurities with which the zinc is always more or less associated. After a time these impurities become dislodged,

and fall to the bottom of the tank or vat, and may be collected and separated in any well known manner. Claims:—1. In the purification of crude or impure zinc, and the extraction of zinc from its ores by electrolysis, the use of vegetable acids or solutions of salts of zinc, prepared with such acids as the electrolyte, substantially as and for the purpose described. 2. The process of purifying zinc and extracting zinc from its ores as above described, and consisting in subjecting plates or bars of crude or impure zinc, or the pulverised zinc ore, to the action of acetic or other vegetable acid, and causing the pure zinc held in solution to be deposited on a cathode or negative electrode by passing a current of electricity through the solution, as set forth.

8396. "Improvements in electrical apparatus for preventing corrosion or incrustation of steam boilers and other similar vessels, and for removing the incrustation when once formed." A. J. MARQUAND. Dated June 10. 8d. Claims:—1. Passing a current of electricity from the positive pole of a battery into the water in a boiler through a conductor fixed in the boiler shell but insulated therefrom, the shell being connected electrically to the negative pole of the battery. 2. The combination of metallic conductor; stud to which it is attached; ferrule screwed into the boiler shell; tightening nut adapted to screw onto the outer end of the said stud; insulation between said ferrule and stud; positive lead electrically connected to the outer end of said stud; a protecting cap adapted to allow of the positive lead being passed through it, and to screw on to the outer end of the said ferrule; and a boiler shell electrically connected to the negative pole of the battery. 3. An electric conductor adapted to deliver an electrical current into the water in a boiler or similar vessel, and consisting of a perforated box filled with zinc.

10057. "A process for the extraction of aluminium from its fluorides by electrolysis." ERNEST DE PASS. (Communicated from abroad by M. Bernard, and E. Bernard, both of Paris.) Dated July 18. 8d. Claims:—1. The electrolysis of a melted bath where fluoride of aluminium (in the state of a single or a double salt) is used, not as a flux, but as the main electrolyte being subjected to the influence of the current. 2. The use of a brick covering for the metallic tank so as to avoid the filtration of the bath. 3. The use of the tank as a cathode for the production of an alloy of aluminium, or at least of aluminium destined to form an alloy with the metal constituting the tank. 4. The use of a derived current on the tank when it is required to obtain pure aluminium. 5. The use of fused alumina and of fluoride of calcium (or carbon blocks) for the formation of plates, and of the crucible serving for the production of pure aluminium.

14204. "Improvements in medico-electrical apparatus." J. R. HARD and T. WILSON. Dated October 19. 8d. Relates to improvements in binding and contact devices, for use in medico-electrical apparatus. The claims are 7 in number.

17704. "An improvement in telephones." A. C. HERTS. Dated December 23. 6d. Consists in fitting the expansion chamber of the mouthpiece of a telephone with a cone which has a broad circular base, and tapers to a sharp point at its apex. Such cone is fitted with spring clips, which serve to hold it in position when placed in such expansion chamber. By this improvement the volume of sound is considerably increased, and the words are rendered more audible and distinct to the ear. There is 1 claim.

CORRESPONDENCE.

Electric Traction.

Your correspondent signing himself "William Brand," in the last issue of the ELECTRICAL REVIEW, is wrong in his deductions and a part of his statement. The tests upon the incline approaching Westminster Bridge were made to see what current at a given E.M.F. was required to *start* the car with its load *upon* the incline. I presume, if your correspondent *is* acquainted with the road and line mentioned, he certainly has made an incorrect statement. The first incline to be met is that which approaches the railway bridge at Lower Marsh, which is an incline of 1 in 25; turning this there is a decline to Oakley Street, Lambeth, to Kennington Cross. The road is undulating, a rise and a curve at the Horns, again bad to Kennington Gate, following this there is a variable rise to the Swan at Stockwell, then the long rise of Bedford Hill is met, again a decline to Clapham Railway Bridge, then the steep incline of Clapham Rise—*i.e.*, 1 in 30. The recent improvements in the electro-motor are of a most decided character, giving a thorough working efficiency of 85 per cent., *not* laboratory test, but in the haulage of the car, and prove it to be fit for everyday service.

A. J. Jarman.

Brixton, S.W., *May 30th*, 1888.

Secondary Batteries.

In your issue of the 11th inst. you publish a letter on the above interesting subject signed "J."

The secondary cell of to-day is generally supposed to be a different thing from what it was several years back. Are the improvements which we have at the present time due to the shape of the plates or to experience in working them? The latter is, I am inclined to think, the most important, as it is very certain that alterations in the forms of plates were the first experiments carried out by early workers.

As a result it is hardly possible to devise a battery plate grid or retainer for a Pb. cell without finding at a later period it has been done although not perhaps generally known.

From the remarks of "J." in this direction he seems to be under the impression that he or one of his friends has discovered a new shape which is comparatively indestructible. It must be admitted by those generally who have taken an interest for any length of time in the progress of secondary batteries, that to a very great extent the credit is due for the storage cell as it is at the present time to the E.P.S. Company, who at an enormous expense have upheld it and carried it successfully through its infantile stages, and as demand arises can, I have no doubt, supply for any purpose cells which will compare favourably with others.

It appears to be a bad way of introducing one's idea by attempting to depreciate another's. "J." states that he has watched the progress of the secondary battery from the time Mr. Volckmar (should this not be Sellon and Volckmar) had the little installation in Hatton Garden, and considers it unfortunate that little has been done to improve those weak points; this, I think, is hardly true, as there is not a point in the construction, manipulation, and commercial production of the secondary cell which has not been practically solved.

I think that the good all round impression which cells are giving at the present time is ample proof of this statement. Putting personal interest on one side, "J." also says it is apparently claimed by Mr. Sellon and one or two others that they have the sole right to manufacture accumulators, which accumulators he has no hesitation in saying can be made to last twice as long by adopting his fancy, which I imagine to be a form of plate which locks or keys in the active material.

He further says, do not the E.P.S. patents consist of the form of plate and the method of manufacture? and he well remembers when Mr. Volckmar came here there was no question as to what the plates were to be made out of, the question was how he (Mr. Volckmar) was to make them. "J." must be under the impression that the E.P.S. patents are Volckmar patents and no others.

Is it possible for "J." to imagine that at that happy moment when he saw the little installation in Hatton Garden and realised the importance of secondary batteries, that others had been at active work on the subject?

There is little doubt that Mr. Sellon was working in this direction before Mr. Volckmar in England; many and extensive were his experiments in shapes, material, &c.

It is possible that "J." was not acquainted with this fact, or surely he would give credit where it is due.

It is obvious that secondary battery plates can be made in many forms; however, there is little doubt from what I know of the numerous patents owned by the E.P.S. Company that it is next to impossible to construct a secondary battery of lead of any practical value without infringing the same.

This is a hard fact, but not so hard when we consider that a secondary cell constructed of lead is not a very difficult thing to invent when we know all about it. It can easily be conceived that unless a company had properly secured patents it would be a bad look out for those who have invested large sums of money, or in other words, it would not be a very valuable property

when (as at the present time) people are beginning to understand it and to realise that the most simple and reliable thing in an electric installation is a secondary battery.

Henry A. Kent.

Notes on Electrical America.

While Mr. Swinburne and Mr. Sellon were in Pittsburgh, they missed seeing a very interesting incandescent installation at the Hotel Duquesne. This consists of 300 16-C.P. Swan lamps, two 150 light Brush dynamos, just like the Brush arc machines, but wound for incandescent lighting. I enclose some notes I made last June which might perhaps be of some interest. The progress made by the Westinghouse Electric Company is, I believe, without parallel in the history of electrical engineering.

I am pleased to see that the above-named gentlemen agree with the views I expressed nearly three years ago in your Journal, viz., that while the arc light installations are carried out in a careless manner in the States, the incandescent fittings are, on the whole, much better than those in this country.

Charles Lever.

Bowdon, Cheshire.

Technical Reports.

For your correspondent's better information respecting the route from Westminster to Clapham we may state that the car was *stopped twice* upon the gradient, and started again when perfectly still, in order to test the performance of the motors and gearing; and, further, that the incline from the railway bridge at Lower Marsh is equal to that at Westminster Bridge, and Clapham Rise is 1 in 20. We would also advise him to be careful in the future when denouncing the statements of others as deliberately false, especially in cases where the disputed points do not rest upon the unsupported observations of one person only, but of several who were not interested in the success of Mr. Jarman's car in any way whatever. We may take this opportunity of stating that we feel perfectly justified in giving an accurate report, when required to do so, based upon our own actual observation, and stating our opinion thereon in a perfectly independent manner, without fear of subsequent criticism, private or editorial.

It is a pity that the custom of employing a professional jester has fallen into disuse, since it is evident that the jocular vein of your correspondent, combined with his scientific attainments, would enable him to rival Chicot or Siel Wetzweiler, and would in those days undoubtedly have secured him a Court appointment.

Fredk. Walker and Hyde.

May 28th, 1888.

[We do not see that our correspondents place the matter of their report in any clearer light, nor does their avowed fearlessness of private or editorial criticism in a case like this commend itself to our admiration. It does not require any great powers of perception on the part of the readers of Messrs. Walker and Hyde's so-called report to come to the same conclusion as did we and our electrical contemporaries.—EDS. ELEC. REV.]

Telegraph Survey.

I am glad to observe, from the ELECTRICAL REVIEW of 25th inst., that my paper "On a new system of Survey and Construction for Railway Telegraphs" in your issue of the previous week has met with a response from at least one telegraph engineer, and that one no less a personage than Mr. George A. Neale of the N.S. railway, Stoke-on-Trent.

I shall hope for a response through the medium of your columns from other gentlemen occupying the position of or claiming to be practical telegraph engineers, and if whilst criticising my system of surveying they will give an outline of their own system, we may, in the course of time, arrive at an understanding as to which is the best, and thus do a good service all round. It was this desire which led me to write the paper, and I will wait for some further responses and repudiations before asking space in the REVIEW for a detailed reply.

For Mr. Neale's personal information I may at this opportunity say he has only to take a birdseye view of the existing telegraphs all over the country to see the extreme lack of practical survey.

Arthur E. Gilbert.

May 28th, 1888.

Galvanic Belts and Electrical Quackery.

I take the liberty of sending you the accompanying letters, and one of the pamphlets referred to in my communication to the *Western Morning News*. Mr. Harness seems to feel agrieved, but for what reason I cannot conceive, as no reference whatever was made either to him or his company. The word "electropathic" was, as you will perceive, used as a generic and general term.

In your issue of May 11th, I notice that your correspondent "Out of Harness," in his noble defence of the "eminent one," writes: "He qualified himself as a thorough electrical engineer in all its branches," yet, so we are informed, pronounces "discs" "disses." We are also informed that "he took his M.D. degree in the New World." These degrees, I believe, were sold largely, in fact they went begging; and a very good story is told of a gentleman who got a degree for himself and all his servants and applied for one for a thoroughbred horse, but was informed that no precedent could be found, but they had hundreds of cases in which the doctor's degree had been conferred on asses.

J. Jerritt, S.T.E. & E.

Plymouth, *May 28th*, 1888.

(*Copy of letter published in Western Morning News, Plymouth.*)

SELF-RESTORER ELECTROPATHIC BELT.

Sir,—May I be allowed to draw attention to a pamphlet which is being widely circulated in Plymouth and elsewhere respecting the above belt, which is said to be the invention of a Dr. Bell, Volta House, Wardour Street, London. Most of the matter contained in this pamphlet, as you will observe, does not refer to the belt in question, but contains remarks too filthy for publication, and should be suppressed by law. Your readers will do well to commit it to the flames before even reading a page of the disgusting matter. Should any of your readers contemplate purchasing an electropathic belt, which electrical quacks state will cure all diseases incident to humanity, let me ask them to read the report and correspondence which has recently appeared in the columns of the ELECTRICAL REVIEW, London, which clearly proves the utter uselessness of these so-called electropathic appliances.

J. JERRITT, S.T.E. & E.

Plymouth, 15*th May*, 1888.

(*Copy of Letter received from C. B. Harness, Inventor, and Manager of the Medical Battery Company.*)

22, Oxford Street, London, W.,
May 21st, 1888.

Sir,—The attention of the directors of the company has been called to your letter in the *Western Morning News* of the 17th inst., which contains a gross and deliberate libel, as you are perfectly well aware we have no connection whatever with a Dr. Bell of Volta House, Wardour Street, London.

Our electropathic belt is patented, and the association of our trade mark "Electropathic" with this person's name constitutes malicious damage, for which we shall hold you legally responsible. Please, therefore, to let us have the name and address of your solicitor who will accept service of process on your behalf.

Yours faithfully,
C. B. HARNESS.

Mr. J. Jerritt.

(*Reply.*)

Mutley, Plymouth, 24*th May*, 1888.

Sir,—I beg to acknowledge the receipt of your letter of the 21st inst. With regard to my communication which appears in the *Western Morning News* of the 17th inst., no reference whatever was made either to you or your company. You cannot of course lay claim to all electropathic belts, &c., manufactured. For instance, Mr. Scantlebury, of this town, advertises largely his patent never-to-be-matched electropathic belt.

If the report contained in the columns of the ELECTRICAL REVIEW, London, dated January 27th, is a description of the belt

manufactured by your well-known company, I am under the painful necessity of confessing that in my humble opinion your belt is an excellent specimen of the magnetic and electropathic curative appliances of the present day.

Before taking legal proceedings, be good enough to let me advise you, in the interest of your shareholders, not to run them into any unnecessary expense.

I beg to inform you that I am my own solicitor, and know quite enough of electricity and its applications to conduct my own case.

Yours obediently,

J. JERRITT.

[Some comments upon this matter will be found in our leading columns.—EDS. ELEC. REV.]

Electric Light Conductors.

Mr. Crompton, when speaking recently before the Society of Telegraph-Engineers on the subject of the imperfect insulation of jointed conductors for incandescent lamp circuits, incidentally mentioned that Mr. J. E. H. Gordon has decided, in his large installation at Whitehall, to do away with joints altogether, and to run a separate wire from the generating plant to each individual lamp.

It may interest some of your readers to know that his idea is not new, but has already been successfully applied, though, so far as I am aware, it has never yet been adopted on such an extensive scale as is contemplated by Mr. Gordon.

In a torpedo boat for the Chinese Government, the electric light arrangements of which were designed by myself and carried out by Messrs. Sir W. G. Armstrong, Mitchell & Co., of Elswick, rather more than a year ago, a similar plan was employed.

There were, in all, some thirty incandescent lamps on board the boat in question, and a separate wire was run to each of these from a distributing switchboard, where the wires were all joined up to the dynamo through separate cut-outs. The steel plates and frames of the vessel were used for the return circuit.

The reasons that led to the adoption of this system in this particular case were several, the principal one being that the wires had to be run in places where it was almost impossible to get at them, and where joints would therefore have been very difficult to make or repair; but the further advantages of better insulation resistance—a point of considerable importance in a torpedo boat liable to be washed over with salt water—less liability to fracture of the conductors by the great vibration to which torpedo boats are subject, and the important points that the cutting of one wire by a rifle or machine gun shot would leave the others intact, and any short circuit produced by a similar or any other cause would melt only one cut-out fuse, and thus put out only one lamp, were also taken into account.

No wood casing was employed, the wire used being all lead-covered, and fastened up by means of stamped metal clasps, according to the system introduced for ship lighting at Elswick some years ago, and which is, I hear, now being taken up by the Admiralty.

It only remains to be added that the installation was perfectly successful, and, though the cost of the conductors was necessarily rather more than usual, the labour of putting them in place was considerably less than would have been the case had the ordinary system of wiring been employed.

A. A. Campbell Swinton.

May 28th, 1888.

Railway Accidents.

In your issue of three weeks since you had a chapter headed "Railway Accidents," and specially described that at the North Kent East Junction, near New Cross, on the South Eastern Railway, which occurred on February 15th last. The accident was one showing the value of the lock and block system, invented and brought into practical use on the London, Chatham and Dover Railway by me in 1875.

It is now published as "The Sykes system of interlocking railway signals and points with block instruments." A few remarks may be deemed by you of sufficient interest to your readers for publication, for which service to myself I shall be much obliged.

The details of the accident, and its cause, need not be recapitulated beyond the brief summary, that had the signal levers been interlocked with the block instruments, according to my system, the accident could not have occurred, despite the signalman, Parrot's, incorrect sight and memory, and consequent action of the lad, because the fact that "line clear" had not been given from North Kent East Junction would have mechanically prevented the lowering of the up distant and up starting signals on receiving the "train on line" signal for the up passenger train from Strood; and, moreover, until the Bromley up goods train was past the North Kent East Junction signals, the signalman there could not give "line clear" to the signalman, Parrot, at the East London Junction cabin.

I am bringing into greater publicity a system of signalling which, after many years' test upon the whole mileage of the London, Chatham and Dover Railway, the District Railway, the Hull and Barnsley Railway and others, can be absolutely relied upon; and I am further able to show that in addition to the safety ensured by the substitution of electro-mechanical means, entirely beyond the control of the signalman, whereby his movements are directed, instead of being wholly dependent upon his correct sight, memory, and attention to his duties; that my supply effects considerable economy both in first cost and maintenance. If of sufficient value to you, I shall be happy to supply such material for publication as you may consider of interest; and if this letter will induce a further space in your paper upon "Railway Accidents," I will take the opportunity to refer to the explanation given in the Board of Trade report upon the accident, and cause of same, which occurred on the Metropolitan Railway on March 19th last at Devonshire Street signal box, between Portland Road and Baker Street stations. While I naturally demur to the supply by Mr. Spagnoletti of a lock and block system for that railway, as my patents are still in force, it is a pity that his conception of the system is so faulty in its mechanical and electrical details, because not only does the electrical failure which caused the accident bring into disrepute the "lock and block" system, but it supports the prejudice against electrical arrangements which has been more or less general.

The Board of Trade report advised that any failure whatever should throw all out of gear, or in other words, "block the road" until all was put right for safe working.

This principle is everywhere maintained in my arrangements. I can invite the closest inspection, and in reply to the special electrical failure which led to the accident, I can state that I patented in 1880 mechanism whereby:

1. An accidental return charge current, if anything, increases the tenacity of my lock. None but a current in the right direction can remove it.

2. The circuit for the lock discharge is so arranged that a stray current from any signalling circuit, or circuit foreign to the signalling, even if in the right direction would be powerless to unlock the signal lever; and in proof of this I can state that during many years' working such a failure has never occurred.

3. In addition to the all important fact that the current for the discharge of the signal lever lock must be in the right direction, the instruments are so constructed that with either an insulated wire and return through earth, or open wire and return open wire with *none* through earth; a stray current, if capable of effect, could only assist in removing the lock when it was *required* to be removed, and would therefore be harmless. I therefore provide means whereby, with extra line wire cost, the electrical failure which led to the accident under notice would be impossible; but I consider that with the ordinary open wire and return through earth being assisted in my circuit arrangement

with the main principle, that "the current must be in the right direction," safety is ensured.

W. R. Sykes.

Brixton Station, L. C. & D. Ry.,
May 25th, 1888.

Anonymous Correspondence.

I should like to join issue with your correspondent "Incognito." My view is that all letters and all articles that are printed in scientific journals, with the exception of one class of letters that I will name, should be signed by the writer, and my reasons are the following :—

In the first place, a *nom de plume* is too often made the cover of personality. A writer will often say things when his identity is concealed that he would not dare to if it were known ; and no editor can justly appraise what may be personality and what is not, as he cannot know all his readers.

Secondly—anonymity, especially in criticism, naturally leads to carelessness. Where a man knows that everyone will be cognisant who is the critic he will naturally be more careful than where the reverse is the case.

The matter is very similar to the two conditions of working in daylight and working in the dark. Where men are exposed to the full light of day, and to the eye of an overseer, whether it be the public or whoever the overseer may be, they naturally work better and practise fewer objectionable tricks than where darkness covers everything.

Thirdly—I maintain that the name of the writer should be added to every communication, for the purpose of gauging the value of the matter contained therein.

When a man has made a special study of a certain branch of engineering, or has had special opportunities of making experience in it, we naturally attach more importance to his arguments than to those of a man who we know has not had the same advantages. On the other hand, I do not see how a young writer can lose by signing his name to his argument, if it be a good one ; and I take the broad ground that if what a writer has to say is calculated to bring ridicule on his head, either he ought not to write, or, if he will wait, he will find the laugh on his side later on. In either case the personal signature really works for the writer's good, as well as for the protection of good-natured editors and their readers.

Fourthly—I maintain that communications should be signed for the purpose of toning down the bitterness of wordy battles. It must be remembered that if we strike at all we invariably strike a concealed antagonist as hard as we can, and that it is quite easy, in our ignorance of whom we are attacking, to write something that may strike home in a manner we do not desire, and that has no effect upon the matter at issue, except to embitter our opponent. There are always two or three ways of saying the same thing, and it is always possible to say the same thing to different men in different ways, so as to avoid each man's peculiar susceptibilities. In other words, it is always possible *not* to say that which may give offence when you know who your opponent is.

The one class of cases in which, as it appears to me, *noms de plume* are admissible, is those where a writer has something to communicate which is of advantage to a considerable section of the readers of the journal he is writing to, but the appearance of whose name would be attended with considerable personal loss or inconvenience. To take the cases mentioned by "Incognito," consulting engineers, persons in responsible positions, and senior partners of firms who have ground for criticism should criticise openly. Not to do so appears to me, especially in the case of the latter, to be taking a very unfair advantage.

I take it that the technical Press occupies a similar position to technical institutes, with the advantage that the institute is always in session, and the number of speakers only limited by the good nature of the editor.

But, as in a properly-conducted technical institute no speaker would be allowed to speak without giving his name, so in the technical Press no writer, however eminent or however obscure, ought to be allowed to, either.

Next. The case of junior members of firms, or *employés* generally, whom the public might wrongly consider to be writing with authority. I beg to submit, Messrs. Editors, that the discussion of scientific problems, or the criticism of scientific appliances, is not like the discussion of politics. We are, I take it, all independent thinkers ; if not, we ought to be ; and it is difficult to see how the signature of a junior or *employé* can possibly bind anyone but himself to any opinion he may express, and only he as long as he happens to retain the same opinion.

With regard to *employés* appearing in print, I imagine the matter stands thus : If an *employé* writes well, or justifies his having written by the value of his contribution, his own value will be raised in the eyes of his employer ; but, if what he has written is twaddle, he will naturally be lowered in his employer's estimation ; and that self-acting rule I mentioned comes in to protect alike the would have been writer, his employer, and that willing horse the reading public.

If an employer objects to an *employé* writing simply because he does not wish his *employé* to shine forth, or to obtain opportunities except through him, the sooner the *employé* seeks pastures new the better for his own future.

Another point that "Incognito" mentions, viz., that a writer runs the risk of being dubbed a fool, because an eminent man said so. I do not think this is a serious matter. Eminent men, as a rule, in these days do not endeavour to keep younger men down in the manner described. Where an eminent man does step out and down, and uses undignified language, or behaves in an undignified manner, for the purpose of sitting upon an opponent, he does himself far more harm than he can possibly do to his opponent.

It must be remembered again, that those who work in scientific fields form a true republic. No man, of whatever eminence, can possibly hold his own by any sort of divine right. Every tyro has the right to join issue with the biggest among us, if he can draw the big man into the arena. And the reading public is a thoroughly impartial one. Other things being the same, a man who has spent thirty or forty years in the study and practice of a particular branch of engineering, must understand a given problem falling within that branch better than a young man who is just entering upon his practice ; or than one who is casting longing eyes from another profession, and who thinks he knows all without study or practice.

And, so long as the former maintains his proper position, the others cannot assail him effectually ; but if with a view of finishing his antagonist, he takes up the feminine style of it is because it is, however galling it may be to the recipient of the information, readers will right him as far as they are able, and that promptly.

But is not the complaint of "Incognito" rather directed to the cessation of the privilege of baiting elders from behind a hedge ? Will the general body of readers lose very much if someone who is afraid to encounter his elders, for fear he may be made to look ridiculous, unless he can do so at a safe distance, and without the reach of the elder's arm, does deny himself the privilege of writing ? Will the general body of your readers ever be much injured if no one writes in your columns who is afraid to sign his own name ? I venture to think not ; and I venture to think that the whole system of anonymous contributions in scientific literature is wrong ; and that in taking the step you have, you have done wisely ; and that the result will be the raising of the tone not only of scientific literature, but of the profession generally, and with it their social status, and possibly their share of loaves and fishes.

Sydney F. Walker.